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National Recreation and
Park Association

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Design for Maintenance

A Park Management Aid

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Preface

This handbook testifies to the critical importance of maintenance in the planning and design of park and recreation areas. Maintenance requirements should be closely examined whenever decisions are made to develop new facilities and programs or alter existing ones.

Whether simple or complex, inexpensive or costly, maintenance continues throughout the lifetime of every recreation area. Whether the continuing task of maintenance is readily accepted and routinely accomplished or whether it proves to be an unreasonable burden and constant irritation depends to a large extent on the care and skill that go into the initial planning and design of every area and structure.

Changes in budget allocations, costs of major budget items, energy demands, patterns of recreational use, improvements in equipment and materials, and increasingly efficient management technology demand an increasingly influential role for maintenance in public park development. Today's park planners and designers must join policy makers and administrators to apply every aspect of available maintenance knowledge to the design of parks and recreational facilities if they are to meet the challenge of cost-efficient public service.

* * *

EFFICIENCY DOES NOT MEAN ELIMINATING ALL HIGH
MAINTENANCE OPERATIONS. EVERY AREA DEMANDS ITS OWN
LEVEL OF MAINTENANCE TO MEET FUNCTIONAL OBJECTIVES.

* * *

This handbook emphasizes the benefits of careful planning and provides direction for incorporating maintenance considerations into every step of the planning process. Unless the planning process addresses maintenance, individual park designs will continue to underestimate the importance of long-term costs. This handbook can:

- o support maintenance personnel who are asking for a greater role in the design and planning of facilities they maintain
- o convince planners and designers of the need to gain deeper insight into the concerns of maintenance and to utilize new tools in the pursuit of cost-conscious design

- o demonstrate to administrators that they must lay the groundwork to support better, more cost-conscious design
- o provide all agency staff with constructive ideas for making both the planning process and individual facility designs more responsive to the concerns of maintenance

* * *

POOR MAINTENANCE IS A POWERFUL DISSATISFIER.

* * *

While public parks are among society's most valued assets, they can also be expensive to maintain. And, adequate funding for operations and maintenance is almost always difficult to obtain. The problem is magnified when areas and structures are built without giving sufficient attention to the continuing problems of adequately maintaining these facilities for public use. The results may include unnecessarily high costs over many years and the need for emergency funding to meet unexpected but avoidable maintenance demands. And, should the park agency become unable to meet its day-to-day commitments, it may resort to the desperate practice of deferred maintenance with accompanying deterioration of public approval, misuse of facilities, and general distrust of the operating agency's ability to provide adequate service.

Good, maintenance-efficient design does not happen in a vacuum. It demands close integration with total agency operations, and particularly with a sound maintenance program that reflects long-range goals, operational objectives, and acceptable standards of performance. Because maintenance-efficient design requires that the agency be able to both anticipate the maintenance operations called for by each design alternative and understand what makes their accomplishment easy, it depends on the close involvement of maintenance staff.

Keep in mind that maintenance represents a major part of any park and recreation operation. The success of the overall maintenance program and the lifetime maintenance costs for each facility depend upon decisions made while "on the drawing board", when writing construction documents, during purchasing, and during construction. Give maintenance due consideration during every phase of park design and development!

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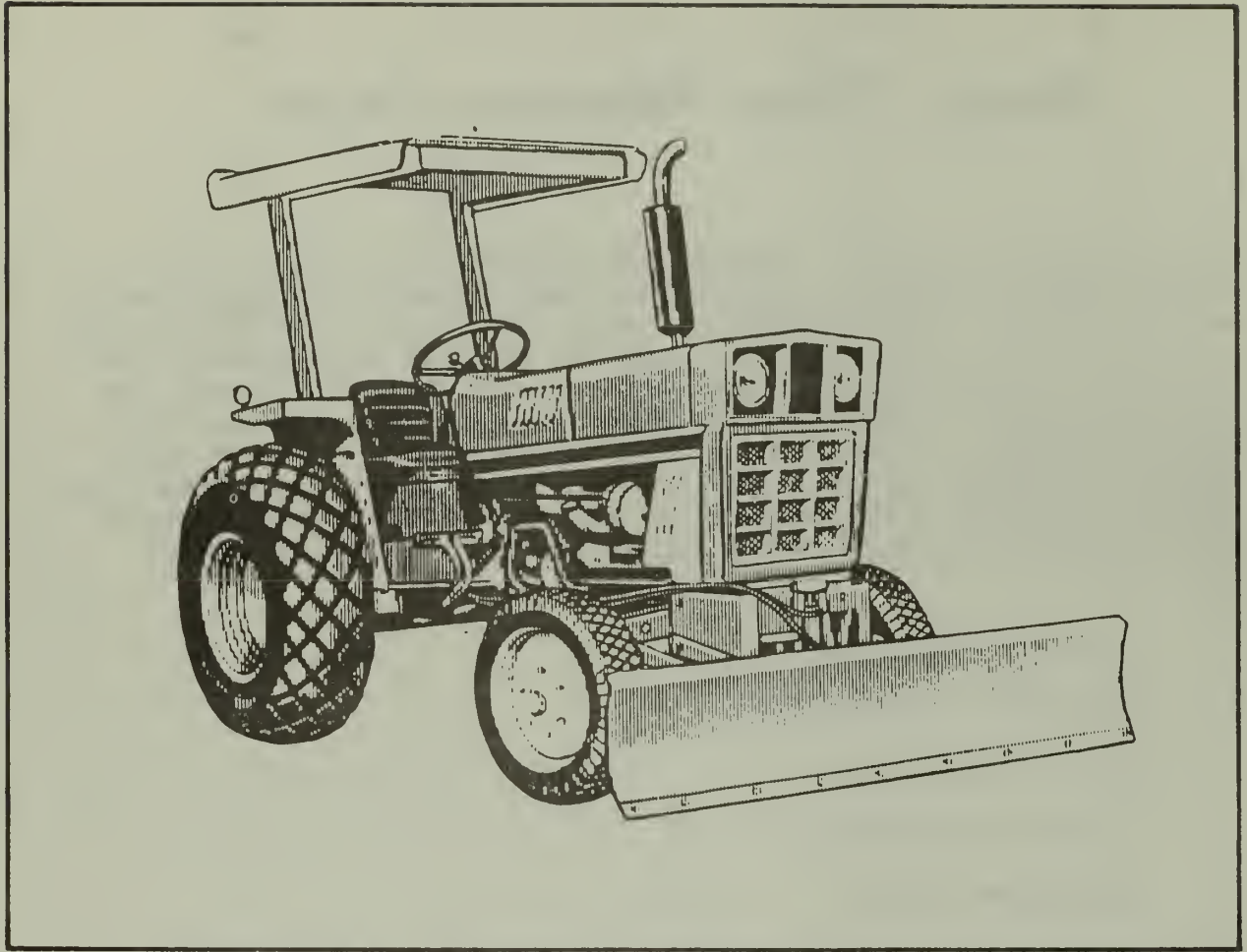
Design: Where Maintenance Begins

This section shows how design for maintenance fits in with other agency goals and objectives, and actually contributes to achieving the overall agency mission of service to the public. In many park and recreation agencies it will be necessary to convince decisionmakers that many service delivery costs and problems begin in the design stage and can be minimized with good planning. In short, it will be necessary to show that design for maintenance pays off. Use this section to make your case that advance consideration for maintenance requirements has a positive and powerful impact on such critical agency goals as:

- o Cost Effectiveness
- o Resource Protection
- o People Protection
- o Public Acceptance
- o Employee Morale

This section has another important message. A successful organization must be able to measure its successes and failures, and be able to show where it is headed, how it intends to get there, and at what speed. This sense of managing for results is essential to successful park management. Design for maintenance needs to become part of such an overall management framework. Only in this way can individual planning and design efforts be seen from a larger, agencywide perspective. As an example, agencies subscribing to management by objectives(MBO) should make sure that design for maintenance benefits from MBO's guiding principles.

- o Set short term deadlines that provide a basis for accomplishment during reasonable periods of time while moving the agency toward its long-range goals
- o Adopt a management style that allows for participation at all personnel levels and provides everyone with clear, measurable objectives.



- o Coordinate efforts to meet common goals, so that everyone has a plan of action and knows when, where and how to do the job.

* * *
DESIGN FOR MAINTENANCE: RECOGNIZE IT AS
AN OBJECTIVE TO WORK TOWARD.
* * *

COST EFFECTIVENESS

Administrators today must manage every aspect of operation with greater efficiency and more detailed attention to cost effectiveness; otherwise operations and maintenance budgets will not keep pace with changing economic conditions.

Consider the following:

- o Low initial construction costs can result in much higher continuing maintenance costs (as, for example, when shoddy materials take the place of quality ones).
- o Attention to maintenance may in some cases actually lower construction costs as when maintenance costs convince an agency to build a smaller, more economical facility.
- o Maintenance costs accelerate with the age of the facility.
- o The costs of supporting poor construction and decay are invariably greater than the costs of planned replacement and maintenance.
- o Labor, energy, and transportation costs are continually increasing.
- o Public expectations are increasing because of constant exposure to better recreational facilities; the public is also demanding increased accountability, more efficient operation, and an assurance that public agencies are living within their means.

The time to save money begins with the first steps in facility design, when decisions can be made that will ease long-term maintenance requirements. It is equally important to consider maintenance when facilities are redeveloped, whether to meet changing conditions or to correct past mistakes. (It makes no sense to restore a facility without considering the maintenance procedures required to prevent future deterioration.)

* * *
MAINTENANCE NEVER ENDS.
* * *

Because maintenance represents an area of major expense, it may also provide a source of significant savings through careful planning. Give proper weight to maintenance as one of the many factors that determine the level of public service you provide.

RESOURCE PROTECTION

Good park management demands that park environments be developed and maintained in ways that assure continuing public approval and use. If park resources are allowed to deteriorate, future users will be denied a quality park experience. Only when consideration for maintenance is an accepted part of an agency's planning process, is there

assurance of accomplishing critical tasks that prevent irreversible damage and the need for costly repair of park resources.

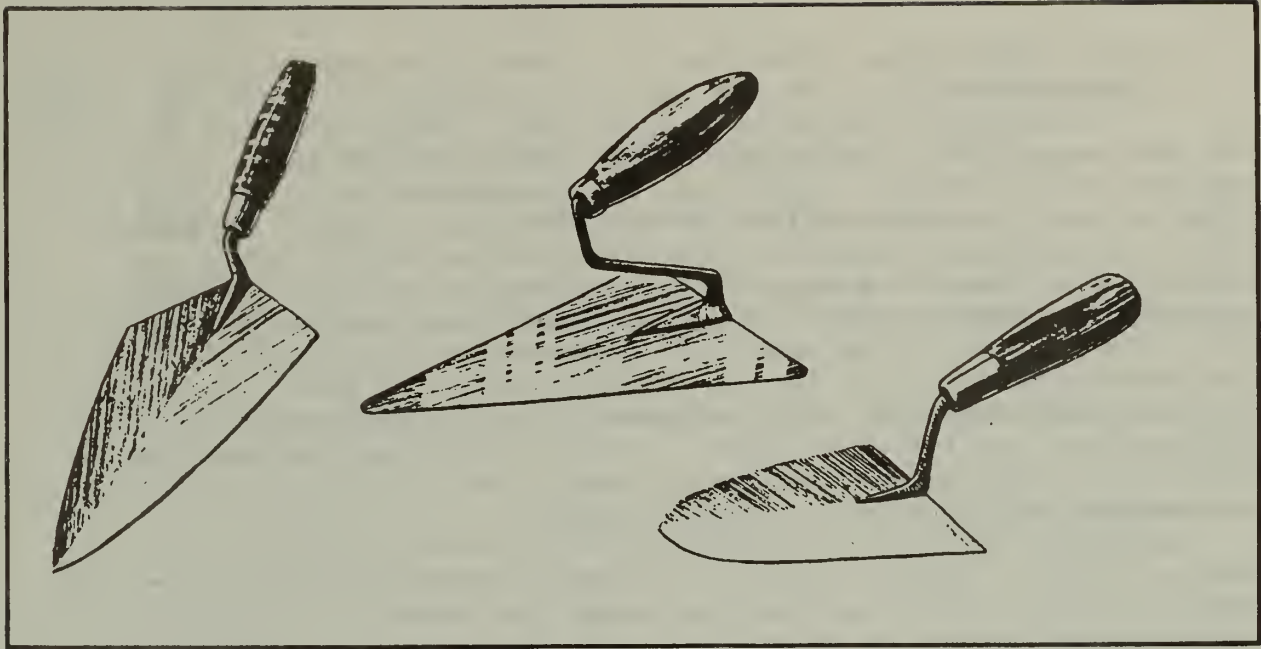
Adequate resource protection demands proactive management and a recognition that different areas demand different levels of maintenance and tolerate different levels of use. By determining ahead of time the level of maintenance required by each area, you will be better able to provide the services needed to protect the natural resource and taxpayer investment and assure its continued usefulness. (You will also be less likely to take on what you do not have the means to maintain.)

- o Anticipate the effects of normal visitor use on the environment and determine the level of maintenance required to satisfactorily maintain it. (For example, you might zone open meadows for no-mowing, occasional mowing, and frequent mowing.)
- o Anticipate changing patterns of use and determine how these can be accommodated as part of an efficient long-term maintenance program. Periodically re-examine areas to evaluate the impacts of changing use.
- o Anticipate that some visitors will use facilities in ways different than intended. Plan facilities to take this additional wear and tear.
- o Select sites and design facilities to accommodate anticipated use efficiently.
- o Consider land acquisition alternatives in terms of future maintenance costs and problems.

PEOPLE PROTECTION

Concern for safety, because it directly affects visitor enjoyment, employee morale, and agency liability for injury, is an essential part of park design and a daily concern of maintenance. Well-maintained facilities do reduce the risk of injuries. No agency can afford to ignore the connection between safety and maintenance during facility design.

- o Design every facility with visitor and employee safety in mind. Analyze both visitor activities and maintenance operations to find potential safety hazards.
- o Try to foresee the unintended and unexpected. Design every facility to minimize future problems. (For example, would plastic be better than glass?)



- o Select maintenance equipment and supplies that are safe for both the operator and visitor under their conditions of use. (For example, could the need for potentially hazardous chemical cleaners be eliminated by a different choice of materials requiring cleaning?)

Many recreation situations involve some danger. Dangerous situations may be made acceptable by good design that will warn and protect visitors. Inform visitors of reasonable risks; bar them from unreasonable risks.

PUBLIC ACCEPTANCE

Whatever an organization does that affects the opinions of those who support it contributes to that organization's success or failure. A reputation for efficiency and resource consciousness pays off when seeking budget support, whether for future development or ongoing maintenance. Good park maintenance establishes an agency's reputation for dedicated service to the public.

- o Is everything clean, neat, and attractive?
- o Does everything work?
- o Does the visitor feel welcome or do you project a "keep out" attitude?

- o Are regulations presented in a positive way at convenient locations?

For many agencies, the dollar costs of vandalism are staggering. However, where public acceptance is high, there is often a positive side effect of reduced vandalism. To insure public acceptance, agencies should from the start offer the community a chance to contribute to design and service level decisions. Keep in mind, however, that most visitors will have little interest in the specific problems of maintenance. They are concerned that facilities be available, in good condition, and that maintenance, when necessary, be done unobtrusively and without inconvenience to them. (Visitors do notice and react favorably to contacts with maintenance employees who reflect enthusiasm and interest in their work!)

Design should always attempt to reduce the inevitable conflicts between users and those who maintain the areas. Irrigation systems that water at night, central trash removal locations, service road/sidewalk combinations designed to accommodate dual use, and efficient interior service storage areas are examples.

EMPLOYEE MORALE

Efficient maintenance comes from good worker productivity and motivation. To a marked degree, the quality of a park operation is determined by the performance of maintenance workers whose jobs may be routine, dirty, and dull. Collectively they control the appearance of the park and the degree to which visitors enjoy their stay. Since maintenance workers are often the only contact visitors have with an agency employee, it is important that they be courteous, knowledgeable, and enthusiastic about their organization.

The maintenance worker is often the one person knowledgeable about the myriad of small details that determine the ease or difficulty of performing the job. Yet this knowledge is often overlooked when designing facilities and planning for maintenance operations. When employees feel their efforts are not recognized or feel uninvolved in decisions that affect their work, productivity declines and the organization is deprived of a valuable source of input. Good two-way communications are the key to developing the kinds of good work attitudes that visitors appreciate and to receiving responsible contributions for improving work performance.

* * *

MAINTENANCE SUCCEEDS OR FAILS LARGELY ON THE BASIS OF
EMPLOYEE ATTITUDE AND CAPABILITY.

* * *

Make input into the design process, as well as orientation to policies and objectives, part of a continuing program of in-service training and open communications.

- o Design facilities that are easy to maintain.
- o Design facilities that respond to good maintenance practices and provide satisfaction and a sense of pride to the maintenance staff.
- o Avoid maintenance practices that tax patience or require unnecessary effort.
- o Avoid designs and maintenance practices that may cause undesirable comment from the public, placing additional stress on maintenance staff.

* * *

DO YOU:

- o ACTIVELY SEEK ADVICE AND INFORMATION FROM THE MAINTENANCE STAFF?
- o INVOLVE THE PUBLIC IN PRELIMINARY PLANNING AND IN SETTING MAINTENANCE SERVICE LEVELS?
- o CONTINUALLY SEEK FEEDBACK FROM PARK VISITORS?
- o CONTINUALLY EVALUATE NEW IDEAS AND SUGGESTIONS FOR IMPROVING MAINTENANCE PRACTICES?
- o CONSIDER DESIGN ALTERATIONS AND ADJUSTMENTS AS AN INTEGRAL PART OF MAINTENANCE MANAGEMENT?

* * *

Design for Maintenance in the Organization

Design for maintenance requires the involvement of many individuals within the organization. This chart borrows from management by objectives to make a point of general value: When administrators, supervisors, and line staff share overall goals and understand the actions required to move toward those goals, progress is certain. Organizations should set timetables and identify quantifiable measures of accomplishment for each required action.

The Agency

Goal: To provide for the leisure needs of the community while achieving maximum operational efficiency.

Objective: To improve maintenance efficiency through producing better, more cost-conscious design.

Required Actions:

- o Develop ability to project and accurately relate maintenance costs to level of service, method of accomplishing tasks, and specific design features. Be able to logically convey these relationships in a way that aids decisionmaking and informs the taxpayer and user public.
- o Establish the policy and procedures needed to insure the following: maintenance input into all phases of design and development; clear lines of communication between designers and maintenance personnel; and tracking of on-the-ground results of design/maintenance collaboration.
- o Incorporate public input on "maintenance-efficient" design options and proposed maintenance levels.

The Administrator

Objective: To establish and support a process that insures incorporation of design features improving maintenance efficiency; to obtain the cooperation of designer,

maintenance superintendent, and recreation programmer throughout any specific project.

Required Actions:

- o Develop format that effectively conveys how future maintenance costs relate to decisions made during initial planning (for example, a maintenance impact statement). See that budgetmakers have cost projections and information on design and service delivery alternatives at the time they act on a project.
- o Based on design and maintenance staff input (as to maintenance requirements, most efficient procedures, and design features contributing to operational efficiency), develop maintenance standards, design criteria, facility checklists, and other tools that offer practical guidance for new facility design and rehabilitation of existing facilities.
- o Coordinate maintenance input throughout the planning and design process for new and existing facilities. Assure maintenance participation in defining the problem, formulating alternatives, assessing impacts, and monitoring results.
- o Give firm direction to contractors and consultants that maintenance impacts are to be considered.
- o Invite and respond to public input on "maintenance-efficient" design and proposed service levels.

The Designer

Objective: To incorporate design features that improve maintenance efficiency.

Required Actions:

- o Discuss with maintenance staff the purpose, uses, design concepts, and construction methods of proposed facilities.
- o Working with maintenance staff, determine what tasks are required for proper maintenance, how to most efficiently accomplish the tasks, whether service levels being proposed can adequately maintain design

adequately maintain design concepts, and which design features might minimize maintenance requirements, mitigate adverse impacts, or improve overall efficiency. Incorporate desired features into design.

- o Provide for the special needs of maintenance, including: delivery of supplies, storage of supplies and equipment, utility outlets, and general accessibility to areas.

The Maintenance Superintendent

Objective: To provide the input needed by designers and administrators to incorporate design features that improve maintenance efficiency.

Required Actions:

- o Keep accurate records of maintenance tasks now performed at each facility, including how performed and with what frequency.
- o Observe and document the effect of design on maintenance operations and user behavior. Provide practical feedback on advantages and disadvantages of design features to designers and administrators.
- o Stay current on new products and trends in maintenance. Provide information that bears on design to designers and administrators.
- o Mobilize the support of all line staff to improve facility design, tapping the specific expertise of every individual.

The Recreation Programmer

Objective: To provide the input needed by designers and administrators to design facilities that improve maintenance efficiency while meeting user needs.

Required Actions:

- o Observe and document the effect of design on user perceptions and on facility usability for recreation. Provide practical feedback on advantages and disadvantages of design features to designers and administrators.

Maintenance and the Planning Process

Even though agencies differ greatly in size, geographic location, and organizational structure, sound planning in any organization is based on a similar series of steps. Because the planning process actually provides a rational and accepted method for solving problems, it can be applied to all areas of management and operations.

When applied to park design and development, the planning process must resolve a tremendous range of issues, from legal requirements to user preferences, from debt financing to neighborhood concerns. Because the maintenance implications of any project seem so far away from initial planning discussions, they are likely to be ignored or to receive less attention than they deserve. Yet we know that early attention to future maintenance problems permanently and profoundly influences the effectiveness and total cost of park operations. This section shows how the planning process can be directed at maintenance during park design and development.

The planning process identifies what happens from the time a problem is first recognized to the time when action is taken and includes provisions to continually evaluate and make adjustments to meet changing conditions. The process has equal application to building new facilities and retrofitting old ones, and can address both physical layout of facilities and integration of new operations. At its most basic, the planning process involves the following sequence of steps.

- o Identify the problem--set goals, objectives and realistic standards.
- o Analyze the problem and select the preferred alternative for action.
- o Implement the plan.
- o Monitor, evaluate and adjust.

(In practice, many steps are involved in bringing a facility on line. In most agencies, the planning process for park design and development expands to include the additional steps summarized by the chart "From Concept to Facility" found on pages 52 and 53.)



IDENTIFY THE PROBLEM--SET GOALS, OBJECTIVES AND STANDARDS

Park planning problems should not be viewed as negative situations. They are more typically opportunities for improving internal operations and visitor services. Taking this broader perspective allows you to identify the factors that are critical to a successful plan of action.

The problem here is to improve maintenance efficiency through better design. It is therefore essential that the design of facilities go hand in hand with planning for both their operation and efficient maintenance.

Without adequate organizational support, you cannot be certain that individual areas and facilities will reflect maintenance considerations. Every agency should lay the groundwork for maintenance-efficient design.

- o Make it systemwide policy to recognize long term maintenance costs at the time a site-specific design problem is first identified.
- o Provide positive incentives for managers and field staff to insure their active participation in carrying out policy (e.g. recognition/cash awards for holding to cost projections or contributing dollar-saving ideas to the design process).
- o Adopt goals, objectives, and (performance) standards for the maintenance operation that are consistent with overall agency goals, while providing clear direction at the field level.

Maintenance performance standards describe how a task will be done and what resources will be used. For example, good standards would indicate: the quality to be maintained (e.g. all litter picked up twice weekly, toilet seats/sinks/urinals kept free of spots); the specific tasks involved (e.g. pick up waste paper, empty receptacles, clean seats, sinks and urinals); the unit of work (e.g. number of sites, acres or facilities); and the resources required (manpower, equipment, and other associated costs). Good maintenance standards are invaluable to the maintenance operation because they:

- o provide the direction needed by staff to consistently accomplish maintenance tasks to a satisfactory level
- o are realistic, reflecting agreement on the "right" balance between what is most desirable and what is attainable with the resources available
- o provide for a wide variety of situations and needs (for example, the common practice of zoning grass areas for different frequencies of mowing, fertilizing, spraying, and cleanup allows each zone to be designed for most effective use of maintenance machinery)
- o show not only what work is being done and what it costs, but how costs break down between the various resources consumed

To insure that standards remain meaningful requires careful recordkeeping and analysis of both the user acceptance of alternative practices and the cost-effectiveness of those practices, given facility lifetime.

When kept up-to-date, performance standards can be a powerful tool for influencing design decisions. Because they can be

used to identify the resources required to maintain any given design, they sharpen agency focus on site-specific design problems. Maintenance standards provide a solid and defensible basis for adapting designs, whether it be to permit new or varied service levels; to allow the use of standardized tools, materials, and equipment; or to improve inefficient operations.

* * *

HAVE THE RIGHT TOOL FOR THE JOB. SIMPLIFY THE NUMBERS AND KINDS OF TOOLS AND EQUIPMENT NEEDED FOR OVERALL MAINTENANCE. SAVE TIME AND MONEY:

- IN TRAINING AND SUPERVISING PERSONNEL
- IN PROMPT RESPONSE TO MAINTENANCE EMERGENCIES
- IN REPLACEMENT PARTS AND REPAIR COSTS
- IN EVERY STEP OF THE MAINTENANCE SCHEDULE FROM TOOL SELECTION TO STORAGE AND REPAIR

* * *

As part of the planning process, it is important to translate overall expectations for the maintenance operation into the goals, objectives, and design standards that will guide the design of a specific facility. (Taking a simple water outlet, the chart on pages 24 and 25 shows how the design process can tie every park unit and facility to overall policies and considerations.)

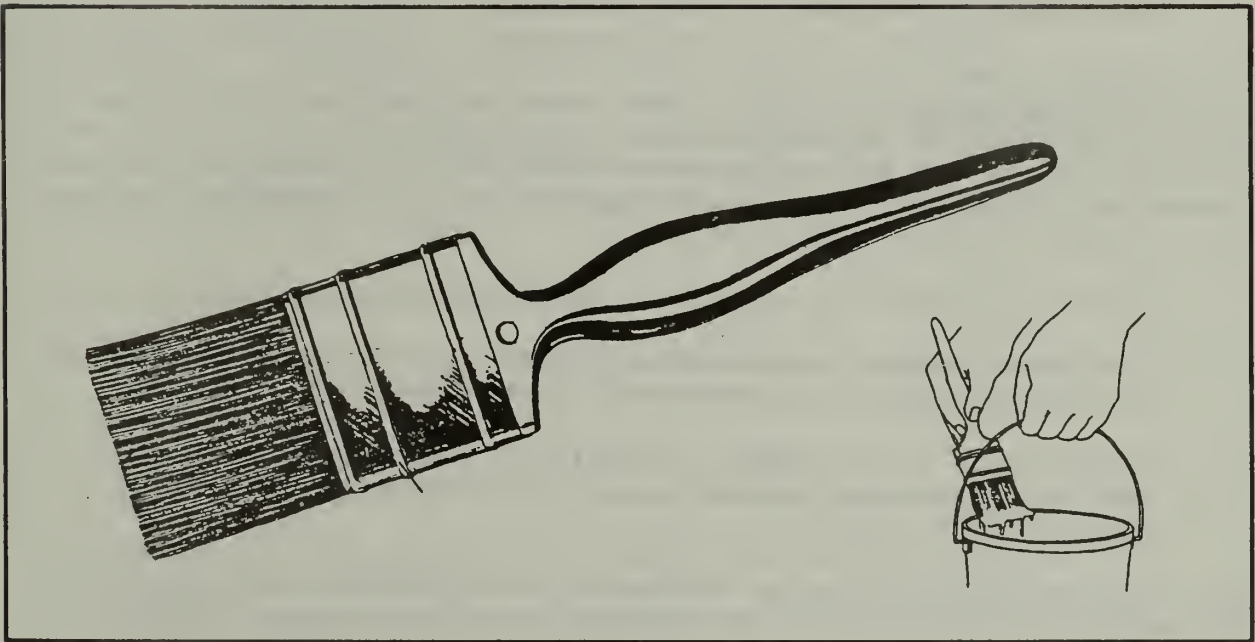
During the planning process, do not limit maintenance input to the details of operation and visitor use. Agencywide issues are involved in the design of every facility.

ANALYZE THE PROBLEM AND SELECT THE PREFERRED ALTERNATIVE

To select the best design alternative, you must understand the effect of design on operations. You will need to analyze every aspect of design for its effect on future maintenance practices and costs. (See "Design and Efficient Operation" for a listing of basic considerations not to be overlooked.) Does the design:

- have maintenance requirements that can be integrated into the existing maintenance organization:
 - in use of equipment and tools?
 - in use of materials and supplies?
 - in scheduling of maintenance operations?
 - in capabilities of the maintenance staff?

- o weigh initial construction costs against future maintenance costs during the life cycle of the facility?
- o permit the level of maintenance needed to assure public acceptance?
- o allow the agency to cost-effectively attain acceptable maintenance standards, minimizing demand on the maintenance budget?
- o require only maintenance practices that do not degrade the environment?
- o contribute to the job satisfaction of maintenance staff?
- o contribute to a well-balanced, efficient maintenance staffing pattern?
- o assure safe use by the public without excessive maintenance problems?
- o incorporate maintenance practices that are acceptable to the park visitor?
- o balance the life expectancy of all its parts against both the life expectancy of the facility and anticipated rehabilitation and replacement costs?



A number of tools and information sources exist to help you analyze a particular situation. Using the available tools and information assures that the planning process systematically brings sufficient and meaningful information to bear on the design problem. Using these tools will also make your viewpoints easier to communicate and defend.

The Maintenance Management System. The existing maintenance management system is one of your best tools for identifying problems or inefficiencies that are design-related. It provides a basis for comparing your facilities against each other and against accepted standards and practices. A good maintenance management system greatly eases the job of analysis by providing a solid base of information that includes: checklists of buildings, structures, and grounds; accurate inventories of equipment and its capabilities and limitations; manufacturer data on product performance; and standards and procedures for all work performed. As already noted, maintenance standards are a particularly vital part of this information base, allowing you to see precisely how a design or operational alternative will affect your need for manpower, equipment, and other resources.

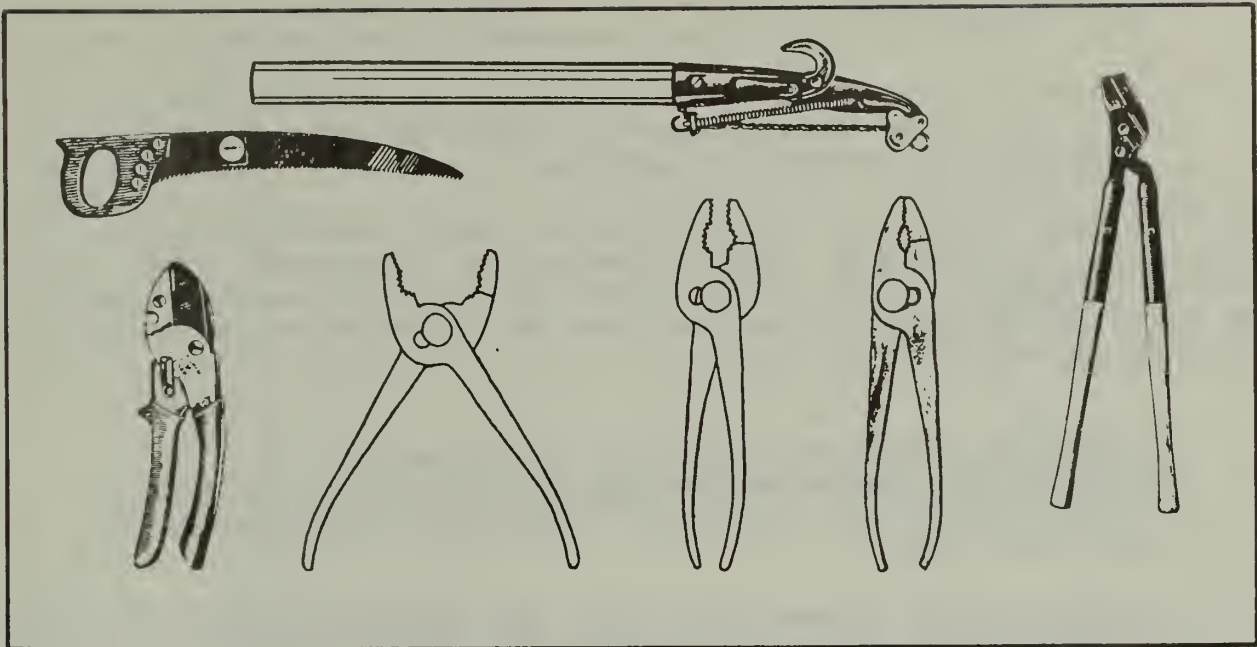
Agencies that lack the detailed and organized information provided by a maintenance management system should, as a first step to analyzing design's affect on the maintenance operation, begin tracking the existing maintenance program at every facility and site.

* * *
KNOW YOUR OPERATION -- ITS PROBLEMS -- ITS COSTS.
* * *

Planning and Design Records. The planning and design process itself can provide an increasingly valuable base of information. From a carefully recorded history of problems and successes, an agency can create new tools to streamline the job of analysis. These might include:

- o lists of preferred plant or construction materials
- o improved design standards or product performance criteria that specifically address the concerns of maintenance
- o checklists (see "Sample Checklists For Better Design") for evaluating proposed facilities on their overall maintenance impact

The Experiences of Others. While it is important to know your own operation, it is just as important to know what others in



the field are doing. Seek out knowledge of new products and investigate new--and perhaps better--maintenance practices that not only improve design but also reorganize, update, and otherwise enhance overall operations. In seeking new ideas, do not limit yourself to public park and recreation agencies. Your counterparts in private sector landscaping firms and theme parks, for example, may have information to share.

The Design Prospectus. Many agencies use a "design prospectus," a document to bring together in a clear, concise manner the many ideas, opinions, and decisions that should guide the design of a facility. While varying in form from agency to agency, the design prospectus can be the first important milestone in the design of a facility, paving the way for more detailed planning.

A typical design prospectus:

- o takes agency goals and objectives from administrative to project level so that decisions on all levels reflect agency aims
- o assures consideration of all inputs that bear upon design
- o directs attention to long-term objectives and costs (for example, to the dollar consequences of changes made in design, materials selection or service levels)

- o instills teamwork by requiring consultation, compromise, and agreement among those responsible for the end product
- o shares crucial information with all interested parties so that the final design solution more skillfully balances competing interests and pressures

Because maintenance is never the reason for creating a facility, it is easy to underestimate its importance. The design prospectus looks at the total picture and insures that no valid perspective, including that of maintenance, is ignored or compromised without reason.

* * *

PREVENTIVE MAINTENANCE IS SMART MAINTENANCE.
ATTENTION TO DETAILS DURING THE INITIAL DESIGN PERIOD
WILL ENCOURAGE GOOD DAY-TO-DAY PREVENTIVE MAINTENANCE
PRACTICES LATER.

- o MAKE EASILY DAMAGED FIXTURES AND MATERIALS (AND THOSE WITH SHORT LIFE EXPECTANCY) CONVENIENT TO REPLACE AND REPAIR.
- o STANDARDIZE REPAIR MATERIALS, PROCEDURES, AND TOOLS.
- o PROVIDE APPROPRIATE STORAGE, IDENTIFICATION, AND RETRIEVAL FOR REPAIR PARTS AND MATERIALS.
- o MAKE AND USE PORTABLE REPAIR KITS FOR ROUTINE MAINTENANCE TASKS.

* * *

Because the planning process must respond to a complexity of pressures and limitations, it is wise to identify several options for achieving agency objectives. This allows decisionmakers to weigh the consequences of each alternative when making the final selection. The final design is always a compromise between many, often-conflicting pressures: funding potentials, political expediency, public review, agency policy and goals, and cost-effectiveness.

IMPLEMENT THE PLAN

Whether the design plan involves construction of new facilities, rehabilitation of deteriorating parks, or retrofitting of buildings, additional maintenance considerations come into play when the plan is actually carried out. In fact, at certain critical points during plan implementation, maintenance input can make the difference between maintenance-efficient and

maintenance-foolish design. For this reason, the maintenance manager has a vital interest in continued involvement in the planning process.

The maintenance manager should, for example, have a say in materials selection and procurement. If purchasing practices deviate from the intent of the designer for lack of knowledge of the impact on maintenance, all earlier efforts to assure maintenance efficiency may be nullified. Maintenance managers can reduce their costs on a continuing basis by insisting on proper product selection based on life-cycle costing analysis and on meeting other pre-determined criteria. (See "Design and Efficient Operation"--Materials Selection.)

* * *

MATERIALS PROCUREMENT DEMANDS MAINTENANCE INPUT AND
REVIEW.

* * *

The maintenance manager can also play a vital role in insuring good construction. Many maintenance problems are the direct result of poor construction. Consider the following:

- o Poor quality workmanship may lead to high-cost maintenance. In-house projects that exceed the capabilities of the work force are especially susceptible to poor workmanship.
- o Substitution of materials may ignore the reasons for their selection--often related to maintenance and supply requirements.
- o Minor misplacement of fittings, outlets, access holes, and valves can lead to continual maintenance problems, repairs, and replacements.

On-site inspection offers one of the best opportunities for effective maintenance input. Good construction requires adequate supervision and quality control. Regular and timely site inspection is most critical in places where further development will hide structures from view (i.e. plumbing and electrical work, buried irrigation systems and footings). Maintenance staff participation in site inspection can prevent serious problems in workmanship from being passed from contractor to maintenance budget. Additionally, maintenance staff can detect changes in design or materials that will adversely impact maintenance. (See "Design and Efficient Operation"--Construction for additional information on maintenance considerations before, during, and after construction.)

MONITOR, EVALUATE, AND ADJUST

The maintenance operation should be monitored and evaluated continually to determine where efficiencies can be realized, how operations can be improved, and what design changes are needed for the future. Some agencies utilize a "post occupancy evaluation"(POE) to track the effect of each and every design on operations. (See "Selected Case Examples".) During the POE process, critical information relating to a design's good and bad points is set into writing. All agencies should find ways to systematically learn from past successes and mistakes.

* * *

IS THE DESIGN WORKING AS PLANNED?
WHAT MISTAKES WERE MADE WHICH CAN BE AVOIDED NEXT TIME?
ARE PROPOSED MAINTENANCE PROCEDURES BEING FOLLOWED?
ARE COSTS OF REPAIR AND REPLACEMENT REASONABLE?
IS THERE A BETTER WAY TO DESIGN A SIMILAR FACILITY?

* * *

Maintenance employees are perhaps the most valuable and the most underutilized source of information for improving the maintenance operation.

- o Seek their opinions.
- o Develop their powers of observation and analysis.
- o Work with staff to keep and analyze records, including:
 - time and effort
 - materials and supplies
 - equipment performance
 - user misuse and vandalism
 - security and safety problems
- o Encourage staff to be accountable for their records and cost projections.
- o Make sure staff know that their information is being used and their suggestions are of value.

Constant attention to maintenance throughout the planning cycle will build a sharper, more effective park operation. In some ways, the planning process may be more important than the plan on paper, if those involved take the opportunity to learn from it. The best of plans is likely to be imperfect; as part of the process, expect to troubleshoot.

The Planning Process and Maintenance

-- An Example

The planning process works at every level of park planning and design--addressing problems on a systemwide basis or at individual areas and structures. Its value is this: thorough consideration of all factors and viewpoints that produce rational decisions and successful plans of action. As the example here illustrates, the planning process can recognize the needs of maintenance without losing sight of user needs for a convenient, functional, and attractive facility.

Identify the Problem

Provide a water outlet for a high use campground.

Set Goals, Objectives and Standards

Agency goal: To provide convenient, attractive, cost-effective facilities for public use.

Maintenance goals:

- o Unit must be durable yet attractive in its surroundings.
- o Unit must provide adequate water and operate efficiently and conveniently within minimum maintenance costs.

Objectives:

- o To balance requirements for good appearance and easy maintenance (achieved by using wood in combination with colored concrete).
- o To minimize routine maintenance and permit easy replacement and repair (achieved by using standard fittings that are vandal resistant, rust proof, and sanitary).
- o To not inconvenience users nor invite vandalism by facility placement.
- o To provide for all-weather maintenance, and the good drainage needed to insure a dry site.

Standards:

- o Wood: Standard treated pine planks with standard galvanized carriage bolt fasteners
- o Metal: Park standard fittings and 3/4" galvanized steel pipe with 4 inch drain and safety inlet
- o Drainage: Standard crushed gravel and drop pipe turnoff

Analyze the Problem--Select Preferred Alternative

- o Bubbler height for adults with step for children
- o Tap heights for pail, with drainage
- o Riser pipe concealed in wood (no protruding parts that invite breakage)
- o Shop-made unit with simple, non-chrome fittings (chosen over commercial units), no hose bib on self-closing tap, push-button rather than spring-type bubbler
- o Concrete apron with cast iron safety inlet (chosen for its simple daily maintenance over the alternative concrete box with full gravel drainage surface); additional covered gravel drainage around apron

Implement Plan

- o Familiarize construction crew with plans, purpose, and functions.
- o Order materials and verify that fittings are interchangeable and will allow use of standard tools for maintenance.
- o Install water outlet.
- o Inspect all details, especially plumbing.

Monitor, Evaluate and Adjust

- o Observe public use and get public comment.
- o Have maintenance crews check for maintenance problems, evaluate, and suggest modifications.
- o Make adjustments if needed.

Design and Efficient Operation

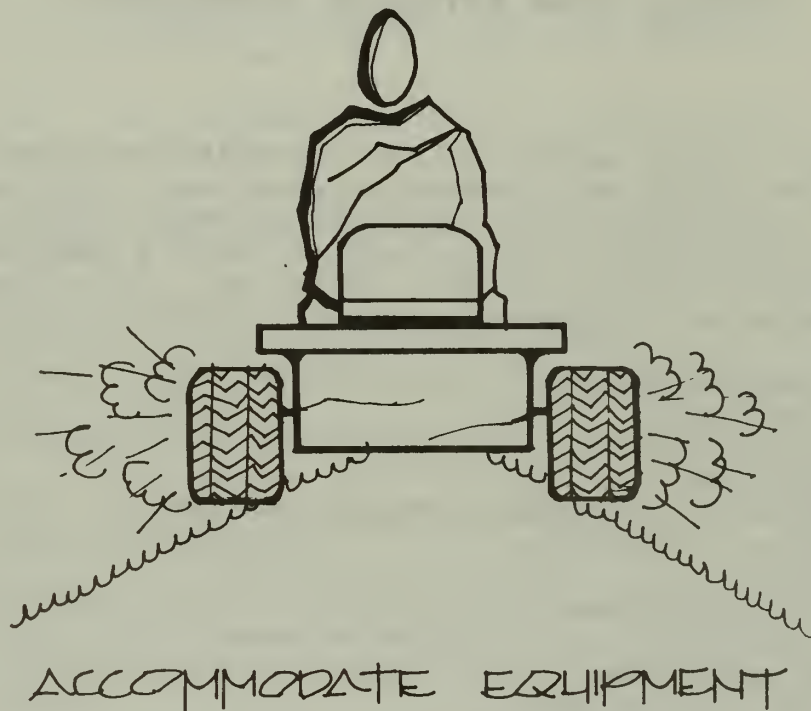
This section takes a number of park planning considerations and examines them from a maintenance perspective. This section emphasizes the variety and complexity of factors that need to be analyzed with input from individuals with a "nuts and bolts" understanding of the maintenance operation. This section looks at maintenance as it relates to:

- o long-range planning
- o site selection
- o carrying capacity
- o circulation
- o equipment limitations and space standards
- o safety and liability
- o vandalism
- o refuse collection
- o pest control
- o energy efficiency
- o grading and drainage
- o water conservation and irrigation
- o plant selection and placement
- o materials selection
- o construction

Because the site-specific design process moves from the general to the particular (dealing first with the overall design concept, basic layout, access and traffic flow and only later providing detailed plans for landscaping, irrigation, electrical and mechanical systems), maintenance input will also follow this pattern. At early stages in the design of a park, for example, it is important to resolve problems with size and placement of facilities, considering such factors as carrying capacity and circulation. Later, attention should be given to increasingly specific matters, for example, materials selection. (See chart "From Concept to Facility", pages 52 and 53.)

Use this section as a checklist of significant factors not to be overlooked and as a source of specific ideas for making design more responsive to maintenance.

* * * * *



LONG-RANGE PLANNING

Agencies should design facilities for anticipated levels of use. They should at the same time consider how changes in use can be accommodated most efficiently and at least cost to the maintenance program. To successfully withstand the test of time, a design must have the flexibility to accommodate new ideas, patterns of use, and ways of operating. A simple example illustrates the point: If fence material of sufficient strength is selected from the beginning, later additions such as tennis screens can be accommodated without tearing.

Because facilities should be designed to require a maintenance level the agency can support, some agencies use a phased approach to development. They design facilities to require only the base level services that can be immediately accommodated, but have a plan to upgrade in the future.

SITE SELECTION

Maintenance should be considered when locating entire park areas as well as the facilities within them. In the critical stages of site selection, many potentially adverse effects on long-term maintenance caused by drainage, prevailing winds, aspect(site orientation), utilities, topography, and access can be modified. For example, when selecting a site for athletic fields be sure to consider depth to water table and depth to bedrock. Too high a table may result in standing water, while too low a table may not support grass. If depth to bedrock is insufficient, rock outcrops may become a hazard.

Some agencies require an "acquisition evaluation" prior to acquiring any new property. The evaluation is based on site characteristics, expectations with regard to use, and cost records on comparable sites over a 5 to 10 year period. The evaluation assures that decisionmakers are informed of problems and projected maintenance costs while acquisition alternatives are still available.

CARRYING CAPACITY

Park and recreation areas should exist to enhance the attractiveness and quality of the environment and its usability for recreation. When designing sites, consider carrying capacity: the optimum level of use above which excessive damage will occur. Always design to encourage this optimum level. For example, limited capacity parking lots, tied in with good traffic patterns, will help protect fragile areas from overuse. Agencies should also recognize the need for various levels of maintenance, based on differences in intensity of use, tolerance for use, and other site conditions. Early in the planning and design of any facility, it is important to take the following steps.

- o Determine the appropriate levels of maintenance for the proposed facility, assign maintenance zones and then integrate these zones into the existing maintenance management plan.
- o Plan to methodically rotate visitor activities within areas and between areas, as needed for environmental protection and maintenance operations.
- o Design circulation patterns to discourage overuse of areas by dispersing users to designated alternate sites.

- o Design areas to concentrate use at "fortified" sites that will receive intensive maintenance, in order to manage adjacent fragile areas with minimal maintenance.

CIRCULATION

Efficient, easy movement of visitors and maintenance crews directly affects maintenance costs. If people can get where they want to go readily and without interfering with other activities, the problems of encroachment, wear on fragile sites, and vandalism brought about by frustration will be materially reduced.

* * *

UNCLUTTER AND UNCOMPLICATE. STRIVE FOR SIMPLE FUNCTIONAL SOLUTIONS IN PARK DESIGNS. THEY ARE MORE LIKELY TO BE UNDERSTOOD AND USED CORRECTLY BY THE PARK VISITOR; THEY WILL REQUIRE LESS TIME, MONEY AND SKILL TO MAINTAIN.

* * *

Follow these guidelines when designing any facility.

- o Anticipate traffic flows and direct them.
- o Provide well-defined, logical, and unobstructed travel routes.
- o Emphasize ease of movement. Visitors have a tendency to follow smooth, flowing, and easily understood routes.
- o Design access points, parking areas, walks, and trails to minimize confusion and simplify visitor decisions as to which way to go. Good circulation routes suggest with a minimum of signs: Go this way. Go that way.
- o Provide for efficient movement of maintenance equipment and personnel in a way that does not conflict with visitor use.
- o Design maintenance roads and walks to support maintenance equipment, by providing adequate curves, turning areas, and room to park and store equipment.
- o Keep people from restricted areas and other places they should not go by making access inconvenient or unattractive and by careful management of traffic flow using plantings, barriers, and topography.

* * *

DESIGN AREAS OPEN ENOUGH TO ACCOMMODATE HIGH CAPACITY EQUIPMENT AND AVOID CONFLICTS BETWEEN MAINTENANCE AND USERS.

- o KEEP SWEEPERS OFF PAVED AREAS WHERE PEOPLE ARE WALKING OR PLAYING.
- o USE SMALL MOWERS WHERE USERS ARE ALWAYS PRESENT.
- o PROGRAM YOUR ACTIVITIES TO PREVENT CONFLICTS BETWEEN USERS AND MAINTENANCE CREWS. SPRINKLE AUTOMATICALLY WHEN GOLFERS ARE NOT ON THE COURSE (EXCEPT IN CLIMATES WHERE GREENS MAY BENEFIT FROM BEING WATER-COOLED AT MIDDAY).

* * *

EQUIPMENT LIMITATIONS AND SPACE STANDARDS

Maintenance equipment may be both expensive and complicated to use. Agencies must know the capabilities and limitations of their equipment and make full use of its potential in every aspect of facility design.

- o Analyze the anticipated cost-effectiveness of specialized equipment. Often an initial investment in specialized equipment and careful planning for its best use, is more economical than continued use of existing equipment.
- o Select equipment, tools, and supplies for cost effectiveness in getting the job done and for employee satisfaction in their use.

* * *

ANY DESIGN THAT REQUIRES HAND WORK BECAUSE POWERED EQUIPMENT CANNOT REACH THE AREA SHOULD BE CLOSELY REVIEWED.

* * *

Design areas and facilities to accommodate the working requirements of existing and anticipated maintenance equipment. Often small adjustments in design can have a lasting effect on the ease and cost of maintenance for the life of the facility.

- o Do the turning radii of roads and paths for maintenance vehicles permit you to accomplish the job with no wasted time or effort?
- o Are maintenance access points, locks, valves, and fasteners selected and located to permit maintenance with

a minimum of simple tools? (For example, can all water lines be adjusted with the same size wrench?)

- o Are panels, panes, braces, and fixtures standardized to permit repair with a minimum of specialized tools?
- o Are turf spaces designed for efficient mowing with a minimum of turns and wasteful moves? Does tree placement interfere with mowing equipment? Do not create small and hard to maintain spaces.
- o Are surfaces to be cleaned--walls, floors, counters --selected to minimize both the kinds of tools and equipment and the kinds of supplies needed to maintain them properly?

* * *

BE SENSITIVE TO SPACE STANDARDS WHEN SELECTING EQUIPMENT.

- o IS THERE ADEQUATE HEAD ROOM AND TURNING RADIUS TO MOVE?
- o IS THE SPACE BETWEEN PICNIC TABLES JUST RIGHT FOR ONE PASS OF A MOWER OR ARE TWO NECESSARY?
- o ARE CRACKS BETWEEN BOARDS ON PICNIC TABLES SELF-CLEANING, EASILY CLEANED WITH THE TOOLS AVAILABLE, OR DIRT CATCHERS?
- o ARE FIREPLACES CLEANED BY ONE PASS OF THE SHOVEL OR ARE TWO NECESSARY?
- o IS THERE ADEQUATE ROOM FOR THE WRENCHES THAT ARE NEEDED TO OPEN TRAPS OR LOOSEN VALVES?

* * *

SAFETY AND LIABILITY

Make sure design meets the safety requirements of both maintenance personnel and visitors (and fullfulls federal, state, and local regulations). Safety of park personnel demands:

- o adequate ventilation in work and storage areas
- o slopes and turns designed within equipment limitations
- o accessible and easily serviced fixtures

- o proper size doors, gates and access roads
- o materials and equipment that are safe to work with and on

Safety of the visitor demands:

- o design of facilities and selection of materials for both minimum hazard and easy maintenance; for example, wood for tables that will not splinter, recessed bolts and nuts where visitors may scrape against them, and non-skid floors
- o keeping people away from dangerous areas
- o adequate lighting and signing
- o properly designed stairs, ramps and walkways



Design for SAFE
maintenance

VANDALISM

Vandalism is the plague of parks. Its cost in maintenance and frustration is enormous. Good design can do much to alleviate the problem by minimizing an important element--opportunity. Good design invites appropriate use, and a park full of people is perhaps the best deterrent to vandalism.

* * *

MAKE ADVERSE USE SO INCONVENIENT--USING BARRIERS,
PLANTINGS, AND CIRCULATION PATTERNS--THAT THE USER'S
SELF-INTEREST PREVAILS.

* * *

The first question to answer is, "What do patrons really want at this location?" When patron needs at a particular location match the function for which a park is designed, problems of abuse are minimized. The next question to answer is whether specific features are really needed. Restrooms are a favorite target of vandals. Often they are not needed in small parks. Sometimes they can be combined with other building functions to discourage vandalism. Misuse can often be discouraged by combining structures with or placing them near related-use areas.

Taking precautions in the following four areas can further reduce vandalism.

o Visibility:

- Use open spaces and carefully designed lines of sight to make observation by police and visitors easier, thus discouraging vandalism.
- Where possible, select sites for good visibility from the surrounding neighborhood.
- Light dark areas and remove hiding places.
- Make structures visible from parking lots, roads, and patrol points.

o Access:

- Provide for easy access by vehicles and staff from streets and parking lots.
- Design entrances to be seen from other buildings, parking lots, and paths.

- Make circulation patterns open and accessible by emergency vehicles.
- Locate lights where they are not easily broken.
- Make roofs hard to reach.

o Visitor acceptance:

- Design truly functional parks that fulfill needs and encourage appropriate use.
- Carefully plan parks to unobtrusively direct people toward appropriate use. Design facilities so it is easier and more logical to use them properly than to misuse them. Careless misuse of facilities is a major contributor to maintenance costs.
- Design attractive facilities that are respected by visitors and less likely to attract vandalism and careless use.
- Instill pride with good design and attractive landscaping. Well-maintained, clean facilities reduce vandalism and contribute to community pride and support.
- Document and publicize incidents to give credibility in the press and stimulate citizen action. Without real facts, the taxpayer cannot grasp the impact.

o Vulnerability:

- Use durable materials, resistant to vandalism and careless use. If it looks fragile it invites destruction.
- Use fixtures that by their appearance will not tempt those who would break or damage.
- Use commercial fixtures, sprinklers, faucets, and grates that are unattractive to potential thieves for home use or resale.

For most agencies, existing facilities are the biggest concern. While it is unrealistic to expect to be able to completely redesign and reconfigure existing units, this is no cause to give up. At any point in the life cycle of a facility, you can begin making decisions that will reduce vandalism. For example, one agency now installs stainless

steel walls in new and renovated buildings. Since paint does not adhere well to the walls, graffiti is less. The walls also require less cleaning and cyclic painting. Another agency has begun a program of replacing small "pop up" sprinklers with larger and less attractive sprinkler heads. And remember, where you cannot alter a poorly designed facility immediately, compensate with proactive management.

* * *

MAKE REPAIRS QUICKLY. REPAINT--REPAIR--REPLACE. MANY PARK DEPARTMENTS HAVE A REPAIR KIT AVAILABLE IN MAINTENANCE VEHICLES TO QUICKLY ERASE EVIDENCE OF MINOR MISUSE AND VANDALISM.

"ON-THE-SPOT" MAINTENANCE PREVENTS MORE SERIOUS PROBLEMS. MAKE ALL PERSONNEL ALERT TO MINOR MAINTENANCE NEEDS, WHETHER THE RESULT OF MISUSE OR SIMPLY WEAR.

- o REPLACE GASKETS ON LEAKY FAUCETS.
- o STRAIGHTEN SIGN POSTS.
- o REPLACE GLASS PANES.
- o TIGHTEN HINGES AND NAIL LOOSE BOARDS.
- o CHECK FOR MINOR DRAINAGE PROBLEMS, ESPECIALLY DURING RAINS.
- o REMOVE AND REPAINT CARVING ON WOODWORK.
- o REMOVE PAINT AND CHALK MARKINGS.

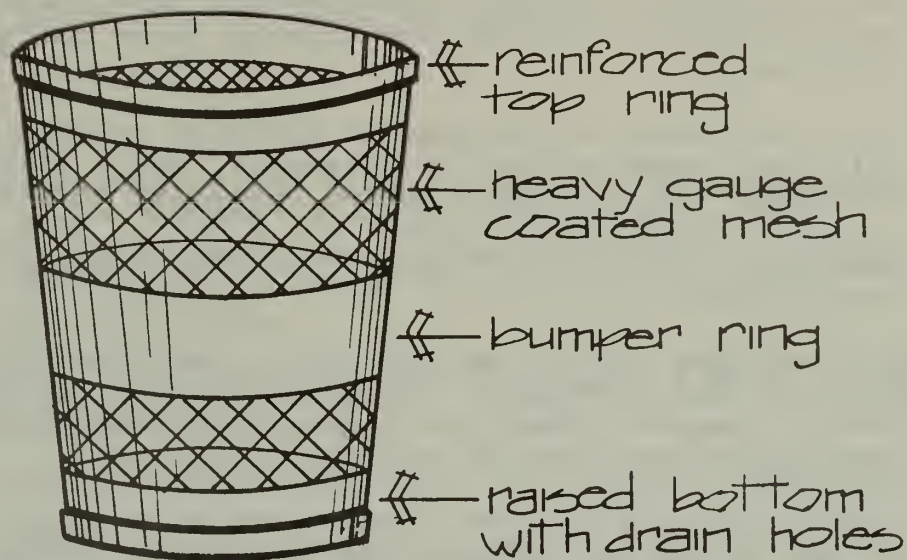
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REFUSE COLLECTION

No maintenance job is more monotonous and yet more important than refuse collection and disposal. Design public use areas and select equipment to facilitate this never-ending job. Each recreation area poses a different problem, with local customs and seasonal changes affecting the kind of refuse collected and the equipment needed. Total collection costs will be based on a number of factors, including: receptacle size, number, and placement; types of collection vehicles and equipment; the internal collection route devised; and inter-site travel requirements.

Receptacles should be:

- o easy to find, attractive, and convenient to use



EASY TO CLEAN
RETAIN SMALL ITEMS
DISCOURAGE VERMIN

- o strategically located to invite use
- o of optimum size and number for the area and pickup schedule
- o compatible with collection and disposal equipment
- o easy to pick up, handle, dump, clean, repair, and store
- o appropriate for the refuse they hold--wet, dry, glass, or small particles
- o durable with adequate life expectancy under heavy use
- o resistant to vandals, pests, and other nuisances, including rats, dogs, raccoons, and thieves
- o secure from tipping and moving, yet easy to empty

Pickup requires:

- o easy access for service vehicles and personnel, with curbs, barriers, gates, and turning radii designed for efficiency
- o collection routes designed to minimize handling and make efficient combined use of personnel, small pickup vehicles, and large collection vehicles
- o equipment cleaning facilities that are convenient and easy to use

Some agencies have cut refuse collection costs by designing for limited collection frequency. They have increased receptacle sizes, built transfer sheds and centralized receptacle locations within use areas to the extent possible.

Other agencies have initiated litter control programs aimed at changing user behavior. By making a continuing litter control program part of the maintenance management plan, litter control efforts at new facilities are made easier. Take advantage of the public relations already carried on by others. (One example is Keep America Beautiful(KAB), Inc., at 99 Park Avenue, New York, New York 10016. This organization makes available KAB Day Kits that contain posters and project guides for businesses, schools, government and civic organizations. KAB also holds award days and otherwise provides support to local litter control efforts.)

In addition to litterbags, signs, publicity, and direct employee-visitor contact, make enforcement of regulations and patrol part of the anti-litter program. Some practitioners have found that posting local litter ordinances and park regulations on receptacles is effective in encouraging receptacle use.

An anti-litter program should also analyze concession operations for opportunities to control wrapper and cup throw-away and should encourage group user cleanup and carryout. Set a good example and insist that everyone in your organization does likewise.

* * *

AN EMPTY GARBAGE CAN WEIGHS ALMOST 30 POUNDS. ITS CONTENTS MAY WEIGH 25 POUNDS. A LOT OF LIFTING CAN BE ELIMINATED BY USING PLASTIC LINERS--WHERE THEIR COST AND VULNERABILITY TO THEFT DO NOT RULE OUT THEIR USE.

A LIGHTWEIGHT BASKET WITH A REINFORCING RING WILL KEEP ITS SHAPE LONGER WHEN BOUNCED OFF TRUCK SIDES.

A BASKET WITH RAISED BOTTOM AND DRAINHOLES LASTS LONGER BY MINIMIZING MOISTURE COLLECTION AND RUSTING.

* * *

PEST CONTROL

Pest control is expensive and time consuming. While some pests are only a nuisance, others are very destructive or even life-threatening. The best time to control pests is in the design stage, by thwarting attacks from the air, from the ground, and from underground.

To lower the costs of controlling "plant pests" (weeds), take the following precautions.

- o Plan to use mulching and rock with a plastic underliner.
- o Plant vigorous plant materials--consider native plants.
- o Determine weed prone areas and design so maintenance can be most efficiently carried out by the equipment or chemicals available.
- o If herbicides are part of the maintenance system, do not use plant materials susceptible to them.
- o Use proper drainage to stimulate vigorous growth and resistance to disease and damage.

To lower the costs of controlling animal and insect pests, take these steps.

- o Eliminate access to habitat.
 - Secure trash receptacles.
 - Place screens on open doors and windows, eaves and vents.
 - Install grates or screens on outside drains.
 - Eliminate small holes and spaces that allow entry.
- o Eliminate attractions.
 - Provide adequate drainage.
 - Provide adequate trash receptacles.
 - Design all facilities for easy cleaning.

ENERGY EFFICIENCY

* * *

SEVERAL YEARS AGO A MAJOR HOTEL CHAIN CONDUCTED AN IN-DEPTH ANALYSIS OF THEIR ENERGY CONSUMPTION. WITHIN THE ORGANIZATIONAL STRUCTURE, THE SINGLE LARGEST DETERMINANT OF ENERGY CONSUMPTION WAS THE HOTEL MAID.

EACH DAY AS THE MAID WOULD TRAVEL FROM ROOM TO ROOM, WINDOW DRAPERIES WERE OPENED, AND LIGHTS, TELEVISION AND THE HEAT OR AIR CONDITIONING WAS TURNED ON, ALONG WITH THE VACUUM CLEANER. OFTEN SEVERAL ROOMS AT A TIME WERE LEFT THIS WAY FOR AS LONG AS IT TOOK TO CLEAN THEM.

* * *

Obvious parallels exist between the above example and the maintenance operation in many agencies. In both situations work is done by traveling crews who can, to a large extent, control energy consumption. Effective design for maintenance can have a major impact on overall energy consumption, but the key to energy conservation lies with the maintenance program. Maintenance personnel are in a unique position to be aware of energy-wasting and energy-saving situations. Make staff aware of problems. Allow them opportunities to suggest how both design and operations might become more energy efficient. Without changing staff and user behavior, the energy-saving potential of design change may not be realized.

* * *

MAINTAINING CORRECT TIRE PRESSURE CAN MAKE A 3 TO 4 PERCENT DIFFERENCE IN FUEL CONSUMPTION.

USING A HEAVY TRUCK FOR OFF-SITE COFFEE BREAKS CAN BE AN EXPENSIVE PRACTICE.

* * *

Energy will be saved most simply by designing areas and facilities to require less maintenance. In this way, many energy-saving measures save maintenance time as well.

- o Design for use of the most fuel-efficient maintenance equipment and supplies.
- o Give thought to circulation patterns, both in facilities and between facilities.
- o Identify design alternatives that reduce the frequency and the duration of maintenance tasks.

- o Keep records of fuel consumption, routine repairs and replacement, and storage as your primary tool for strengthening operations and creating more energy-efficient design.

* * *

CONSIDER THE ACCUMULATED TIME SPENT IN UNPRODUCTIVE MOVING OF STAFF, EQUIPMENT, AND SUPPLIES IN BUILDINGS, IN PARK AREAS, AND BETWEEN AREAS. LOCATE MAINTENANCE CENTERS AND STORAGE AREAS TO PROVIDE THE MOST COST-EFFICIENT SUPPORT TO MAINTENANCE PERSONNEL.

* * *

Buildings should be designed to hold down utility costs. Utility costs are likely to be an increasingly significant part of a building's operations and maintenance budget. When designing any new building, aim for good thermal insulation in roofs and walls; low leakage of air; and high performance from heating, ventilation, air conditioning, lighting, electrical and water heating systems. Here are some specific areas to examine.

- o Building Orientation and Shape. Strive for a compact building to minimize surface areas that transmit heat gains and losses. Orient the building for optional sun exposure, given the local climate. Exploit the topography and any trees that can provide shelter. Mitigate against harsh winds or utilize prevailing winds for cooling. Go underground (see "Selected Case Studies").
- o Walls and Windows. Give each wall different treatment, either reducing window area; installing external and internal blinds, shades, screens, and canopies; or selecting heat absorbing, heat reflecting or insulated glass.
- o Thermal Insulation and Structural Leaks. Use better thermal insulating materials and heat retaining materials. Try to place entrances on the building's downwind side and to incorporate sealed-chamber vestibules. Investigate impermeable exterior surfaces.
- o Mechanical Design (Heating, Ventilation, Air Conditioning Systems). Design for lower thermal environment standards. Do not buy excess capacity; provide adequate zones of control; and, where possible, use a waste heat recovery system. Incorporate automatic controls that allow more precise control of the building environment.

- o Lighting Design. Set realistic standards for amount of lighting needed, designing for the specific activity or function anticipated. Allow local control of switches. Aim for reducing both power consumption and the need to remove waste heat.
- o Solar Energy. Use it when climate and location are right and you are building a good, heat-conserving structure.

If possible, inventory and compare energy consumption rates at existing buildings. This is a good way to begin gathering the data base needed to assess the effects of design on energy consumption and the effectiveness of conservation measures already taken. Additionally, the information can help you determine which of your existing buildings are the worst energy drains. Before undertaking an extensive retrofit project at an existing building, consider anticipated savings over the remainder of the building's life expectancy. Some relatively inexpensive changes may have a better payoff.

- o Tightened Building Envelope. Stop air leaks at windows and doors through recaulking; weather stripping; installing double glazed windows, insulated panels or storm windows; and adding indoor and outdoor shading.
- o Improved Lighting Design. Change to a more efficient light source. Make sure walls, furniture, and other internal surfaces are high-reflecting.
- o Adjustment of Heating, Ventilation, Air Conditioning Systems. Make sure all equipment is functioning at peak efficiency. Reduce levels and hours of operation.

Energy conservation efforts exemplify the inseparability of design and operations. A successful program will identify opportunities to change operational procedures and user behavior, modify existing facilities, and make new facilities more energy efficient. To do otherwise is to risk unnecessary expenditures to obtain less than satisfying results.

GRADING AND DRAINAGE

Water, uncontrolled, is a menace not to be tolerated in public parks. No single area of design has a more profound long-term impact on maintenance than does drainage. Good decisions relating to location, choice of materials, and construction techniques can be neutralized by bad drainage. Good drainage engineering goes unnoticed yet the results of poor engineering may cause maintenance costs to skyrocket.

Bad drainage can produce:

- o excess water in the wrong place
- o corrosion and rotting of materials
- o erosion of earth and paved surfaces
- o loss of plant materials
- o cracked surfaces and foundations
- o slumped road shoulders
- o unmowable turf and flooded playing fields
- o water-covered walks and roads

To minimize drainage problems, you must know exactly where water will go and how it will be controlled, whether from a faucet, drain, roof, turf area, or parking lot.

- o Design drainage systems carefully, in response to local rate of precipitation, percolation or internal drainage capability, size of area to be drained, and public use requirements (for example, the slope allowable for a specific activity).
- o Design areas for quick, efficient pickup of water into drain lines that also catch debris for quick removal. Drain lines should be self-cleaning and accessible for maintenance.
- o Design buildings so that moisture cannot collect to cause corrosion or rotting and so that runoff is carried away in controlled lines.
- o Try to anticipate drainage-caused maintenance problems. This is not a place to skimp on the design and construction of facilities and areas.

WATER CONSERVATION AND IRRIGATION

Many areas are beset by water shortages. But even if your area is not one of these, facilities and irrigation systems should be designed to save on watering costs. For example, you can limit turf-dependent uses (such as foot traffic and sports), select vegetation that is well-adapted to the local climate and environment, and design for the incorporation of maintenance

procedures that reduce evaporation or increase the soil's capacity to hold water (e.g. mulching, composting).

Your water conservation efforts depend on an irrigation system that uses water efficiently. A good irrigation system confines water to where its needed and to the amounts needed. It also enhances the entire maintenance program by, for example, aiding plant growth and preventing the runoff and flooding that aggravate erosion. To plan an irrigation system that both uses water efficiently and is compatible with the maintenance program, give thought to such variables as:

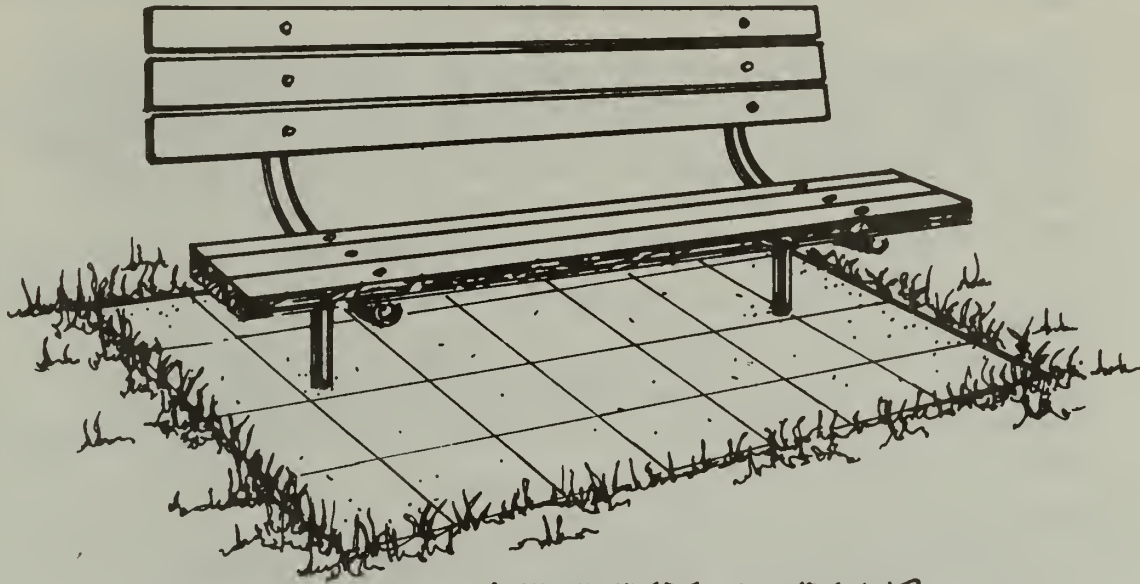
- o types of plants being watered, their moisture requirements and root depths; number of planting areas with differing requirements
- o environmental conditions, including soil, topography, temperature range, and winds
- o available water reserves (should you consider reclaimed waste water?)
- o program-related limits, including period of time available to water
- o operational requirements of the system, including labor saving features, availability of parts and services, compatibility with inhouse equipment, and staff expertise (is the agency able to keep the irrigation system well controlled and timed?)
- o advancements in irrigation technology
- o flexibility to expand or modify the system

PLANT SELECTION AND PLACEMENT

Decisions about plant selection and placement are best made up front, during the initial design of a site. Select plant materials that meet site conditions and are adaptable enough to require little special maintenance. Then, locate them to permit easy access by maintenance staff. Always keep in mind that plant growth and vigor is dependent on these factors: soil, climate, water, sun exposure, and drainage.

Many maintenance problems can be avoided by simply giving plants the room to grow.

- o Provide plants with space for healthy root growth.



MINIMIZE WEAR
SIMPLIFY MOWING

- o Provide plants with room for good final, mature appearance with minimal trimming.
- o To maintain a good appearance until plants mature, try double planting of small stock. You can remove some of the stock later to make room for other planting.

* * *

SELECT PLANTS CAREFULLY, AVOIDING--OR LOCATING AWAY FROM BUILDINGS AND PEDESTRIAN AREAS--THOSE THAT ATTRACT PESTS.

- o PURPLE SALVIA ATTRACTS BEES.
- o BOX ELDER ATTRACTS BEETLES.
- o HIGH SHRUBS AND HIGH GRASS HARBOR TICKS.

* * *

Always plant with an awareness of maintenance operations and problems.

- o Avoid monocultures. Single species plantings are prone to major damage by disease, insects or adverse weather conditions. (Instead, alternate plant species that host pests with other non-host species.)
- o Group plants for easy maintenance. Allow space for machinery or tools to work around plants efficiently, and group plantings to cut down border mowing costs. Free flowing lines are easier to maintain than lines with sharp corners. Design so equipment can mow without additional, labor-intensive trimming.
- o Locate plants so that they will not be injured by salt spray from snow clearance, oil drip from car bumper overhang, crushing from snow removal, or injury from opening car doors. Use mulch and buffer spacing to protect plants from vehicle damage caused by maintenance crews and the public.
- o Use plants to control traffic:
 - as buffers to keep people from defacing walls and climbing on buildings
 - to restrict traffic on fragile soils
 - to control wear on turf by barring access or guiding traffic flow
- o Use shrubs and ground covers as an economical means of reducing erosion.
- o Avoid dense plantings. They provide undesirable hiding places, and collect wind-blown refuse. Open plantings discourage flies, mosquitos, and gnats.
- o Avoid attractive nuisances, for example:
 - edible large fruits and showy flowers that may injure the plant when people take them
 - small planting stock that may be easily broken or trampled

* * *

REPLACING DAMAGED PLANTINGS IS EXPENSIVE. IN HIGH VANDALISM AREAS, NEWLY PLANTED TREES SHOULD BE AT LEAST TWO INCHES IN DIAMETER AND PROPERLY STAKED.

* * *

- o Locate trees and shrubs to save energy, using them to block or expose sun and wind at the right time. To permit

the sun to shine through in winter, plant deciduous trees on the south side of building. Conifers can break winter winds, but may also cast shadows that result in icy walks.

- o Know your own environment. Even generally good advice may not be applicable to a specific site and climate.

* * *

AVOID PLANTINGS THAT REQUIRE SPECIAL HAND MAINTENANCE NOT PART OF THE NORMAL MAINTENANCE SCHEDULE. LATE FALL PLANTINGS, WHEN WATER SYSTEMS ARE TURNED OFF, MAY IN SOME CLIMATES RAISE WATERING COSTS DRAMATICALLY.

* * *

Designing with trees requires its own checklist of considerations. Ask yourself these questions.

- o Will expensive trimming be necessary? Check for:
 - overhead line and overhead clearance
 - crowding against buildings, scratching walls and windows
 - sight lines at corners and along walkways
- o Will nuisance cleanup be necessary? Check for:
 - broken limbs
 - excessive leaf and fruit fall on golf greens, in swimming pools, and on fairways
 - fruit stains on picnic tables and paved areas
- o Will roots interfere with utility lines or heave sidewalks?
- o Will plants grow to an unnecessary mature height or spread that requires special maintenance?
- o Will special fertilizing and spraying be required?
- o Will roots withstand special site conditions such as compaction, crowding, and extremes in soil moisture content?
- o Will tree placement interfere with irrigation systems?

By giving special attention to the design of turf areas, they can be made less demanding on maintenance staff and resources.

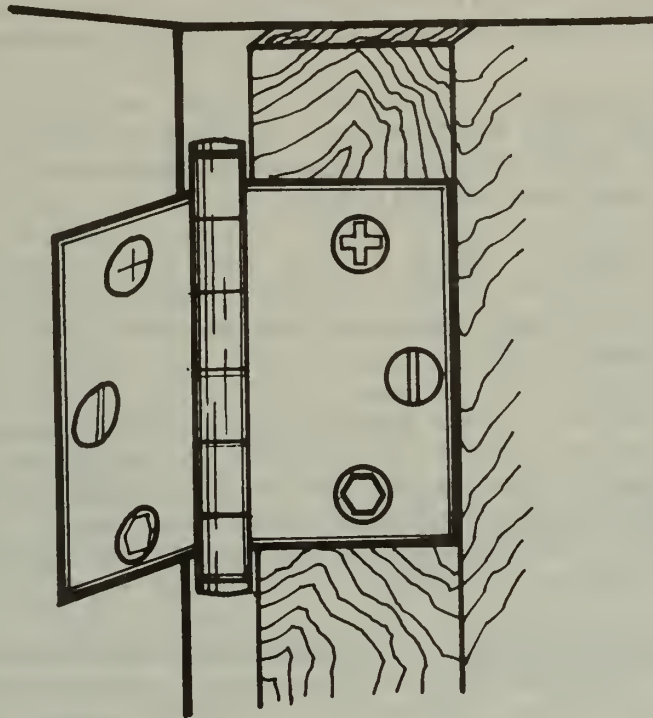
- o Limit turf areas to turf-dependent uses.
- o Select grass varieties consistent with climate, location, and use level.

- o Insist on good underground and surface drainage. Small, poorly drained areas can have major effects on maintenance costs and public perception of the area.
- o Disperse use to avoid worn spots and "fortify" (provide border and containment) with pavement, chips, or concrete, as needed to protect turf areas.
- o Design turf areas for efficient use of maintenance equipment appropriate to the location, size, and anticipated level of maintenance. (For example, do not use different species in the same mowing area if a change in mowing height is required.)
- o Anticipate how land forms, slopes, and planting locations will influence the kind of equipment to be used. (Will placement of play equipment and trees interfere with use of modern mowing equipment? Are mounds and slopes so steep as to be dangerous or produce "scalping"?)
- o Minimize wear by planning ahead for rotating use within turf areas. Design spaces to accommodate changes in the layout of play areas and facilities.
- o If you are using ground covers as a low cost replacement for turf, make sure that the species selected is compatible with the irrigation system and program and does not require severe pruning every year.

MATERIALS SELECTION

The wrong choice of materials will frustrate day-to-day maintenance efforts and have drastic consequences for long-term maintenance costs. When purchasing procedures fail to evaluate products for their ease of maintenance and their contribution to facility life cycle costs, the results are:

- o improper fastenings that cause a structure to collapse
- o the wrong bolt in the wrong place, requiring special tools and additional time for routine maintenance
- o materials that outlast the rest of the structure, representing a wasted initial investment
- o shoddy materials that fail to maintain a satisfactory appearance or condition and therefore lead to visitor disapproval, vandalism, and accident liability



DETAIL! DETAIL! DETAIL!
maintenance never ends
SIMPLIFY - STANDARDIZE

* * *

CONSIDER CEILING-HUNG PARTITIONS AND WALL-HUNG
FIXTURES FOR EASY FLOOR CLEANING. CONSIDER
PLASTIC-COVERED PARTITIONS FOR EASE OF REPLACEMENT AND
MINIMUM CORROSION AND DEFACING.

* * *

Select materials to meet these tests:

- o Durability. Will it stand up under the kind of use and maintenance it will get? Will it hold up under climatic conditions of sun, rain, wind, cold and heat? Will it resist vandalism?
- o Appearance. Does it fit your standards for good appearance? Will it continue to do so throughout its life?

- o Availability. Is it available at acceptable cost both for initial construction and anticipated replacement?
- o Public Acceptance. Will the public accept it as satisfactory and desirable? Will it "invite" misuse and vandalism? Will it hold up under expected use--sitting, standing, walking, handling?
- o Appropriateness. Does it fit the life expectancy of the facility of which it is a part? Does it fit easily into the facility's maintenance program or does it require special attention?

Maintenance managers should aggressively defend product selection based on the long-term costs of maintenance and operations and should be supported by an agencywide procurement policy that gives weight to such considerations. Some public agencies have used the following two tools to insure that products are not selected solely for their low initial costs.

- o Efficiency Standards. Agencies can set reasonable standards for product performance, energy use, need for routine servicing, and other factors impacting long-term costs. These standards serve as specifications when taking bids.
- o Life-Cycle Cost Analysis. When items or materials are purchased in large amounts or for frequent use, and real differences exist among competing products, some agencies compare the alternatives based on the total cost of product ownership, use, maintenance, and disposal over the product's useful life.

* * *

IN THE SOUTHEASTERN REGION OF THE U.S. FOREST SERVICE, THE POLICY IS TO SPEND A LITTLE MORE FOR INITIAL CONSTRUCTION IN ORDER TO REDUCE LONG-TERM OPERATION AND MAINTENANCE COSTS. ALL TOILET BUILDING DESIGNS RECOGNIZE THE PROBLEMS OF STRUCTURES IN A HUMID CLIMATE. BUILDINGS HAVE CONCRETE OR CERAMIC TILE FLOORS AND CONCRETE BLOCK INTERIOR WALLS TREATED WITH A FILLER EPOXY FINISH. EXTERIOR WALLS MAY HAVE A WOOD OVERLAY.

THE RESULT IS A VERY DURABLE AND EASY TO CLEAN SURFACE.

* * *

Those with field experience need to communicate the special demands of the park and recreation setting to those making

purchasing decisions. It does not pay to select products that cannot meet all functional requirements.

- o Keep lists of products and materials that are intense consumers of energy and staff time or habitually cause problems. Use these records to justify the selection of alternate products and to find opportunities to realize new savings.
- o Research materials and their use. The successes of others will make you successful in using new materials. (One park design enthusiast makes it a practice to never go anywhere without a camera.)
- o Experiment--when you can anticipate the consequences. It is usually safer to use old materials in new ways than new, unproven materials in old ways.
- o Do not hesitate to reflect your professional and specialized body of knowledge.

CONSTRUCTION

Construction is a critical time in the planning process. If construction is not carried out according to design, the benefits of good, cost-conscious design may be lost and difficult, expensive repairs may be needed. Good construction will minimize costly, and perhaps permanent, maintenance problems, but requires:

- o adequate planning and design
- o a tight performance contract
- o detailed supervision and inspection
- o the courage to correct mistakes before it is too late (a change order during construction may save on later maintenance costs)

Before construction, make sure that design plans are accurate and complete and that performance contracts have been carefully prepared to reflect maintenance concerns. During construction, inspect and supervise with maintenance in mind. Give attention to good workmanship and to those details essential to preventing such maintenance headaches as:

- o poor drainage
- o leaky roofs

- o cracked foundations
- o rotting, rusting, and deterioration in the wrong places
- o cracked and heaving walks
- o annoying inconveniences for routine maintenance
- o excessive routine maintenance requirements
- o safety hazards for both visitor and employee

As construction concludes, make sure you have taken these last few measures. You will be rewarded with parks that can be maintained with fewer dollars and less frustration.

- o Completion of Cleanup. Make sure final cleanup has been completed. Consider cleanup to be the last 10 percent of the construction job. Good cleanup includes:
 - removing mud on buildings and floors
 - removing extra parts and materials
 - removing buried construction debris that may cause future problems
 - cleaning mud-splattered drip areas under eaves
 - completing performance checklist (in contract document)
 - cleaning concrete washouts
 - cleaning up chemical by-products (such as muretic acid)
 - correcting topsoil overlay or bad backfilling
 - correcting excess compaction by construction equipment
 - correcting equipment storage area compaction
- o Scheduling of Grounds Restoration. Coordinate the construction schedule with grounds restoration. Anticipate the need to control erosion after construction and before the planting season.
- o Compilation of Records. On-site changes during construction are likely to make working drawings unusable as permanent records. Insist that as-built drawings be made available for the record and for future maintenance use. Just as important, keep records on brands and colors of paints, stains, and other often-damaged surfaces, so that exact matches can be made when they are required. A complete list of guarantees, warranties, and parts suppliers associated with development should be furnished to maintenance staff when any project is completed.

From Concept to Facility:

THE NEED FOR MAINTENANCE INVOLVEMENT

STEP IN THE DESIGN PROCESS

1. Set Project Goals. Agency defines design problem, its scope and key factors for consideration; develops list of needs and requirements (design prospectus); obtains initial authorization to proceed.
2. Develop More Detailed Proposal. Agency (planning team, possibly aided by consultant) begins analysis of site and user data; refines needs and requirements, producing the design program that will guide designer.
3. Select Designer and Enter Contract. Agency follows equitable selection process to obtain designer; drafts legally binding document that outlines services or products at each design stage and sets out schedules, responsibilities, compensation, and construction cost estimates
4. Research Options and Develop Schematic Plans. Designer (aided by planning team) educates self on project and identifies issues, problems, and options; determines basic layout, location and size of facilities; shares ideas and options in public forum.

CONCERNS/OPPORTUNITIES FOR THE MAINTENANCE MANAGER

- * Call attention to early decisions and key considerations with impact on maintenance (e.g. site selection, carrying capacity).
- * Begin considering appropriate service delivery method (e.g. inhouse staff, contract, user/neighborhood assistance).
- * Participate on planning team and assert maintenance perspective.
- * Establish tentative maintenance zones and service levels (based on project location, expected use, agencywide goals and objectives); assemble rough cost figures for maintenance.
- * Make sure design program spells out features to include or avoid, as shown by past experience (e.g. maximum grade of slope, type of turf to use, desired radius for road curves).
- * Assist with designer selection (i.e. become knowledgeable regarding competing firms' expertise, researching the strengths and weaknesses of past projects now operational).
- * Assist with forming alternatives; advise of new developments and trends in the field.
- * Check maintenance-related assumptions and conclusions; review solutions to any maintenance issues identified.
- * Assess and call attention to the maintenance costs and impacts of each option being considered.
- * Check schematic plans for major functional relationships, calling attention to obvious problems (e.g. access, traffic flow, appropriateness of maintenance facilities, safety).

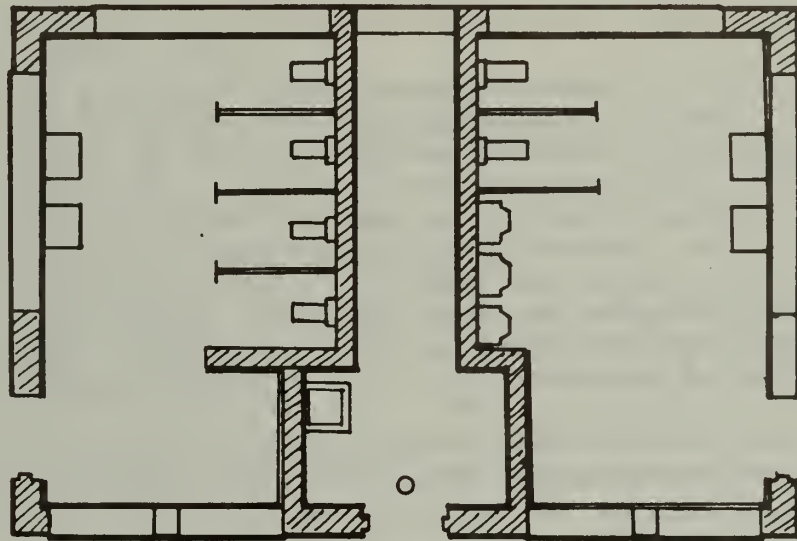
5. Develop Detailed Plans. Designer determines exact placement of facilities, also colors, textures, materials and types of equipment/fixtures to be installed; develops specific plans for grading, irrigation, landscaping; develops building floor plans, including electrical and mechanical systems.
 - * Review plans critically for their effects on maintenance routines (developing "checklists" to speed future review).
 - * Itemize all maintenance tasks; determine whether proposed design is within staff and equipment capability and permits attainment of performance standards. (Are light fixtures too high to allow easy replacement of bulbs?)
 - * Review proposed materials for maintenance-requiring traits and compatibility with existing operation (checking for compliance with design standards, where applicable).

6. Develop Working Drawings/Construction Documents. Designer develops very technical information to serve as precise, clear communication between construction contractor and designer.
 - * Make sure that construction documents identify any sensitive areas or processes that may require special treatment to prevent maintenance problems.
 - * Complete maintenance impact statement and a plan for when and how maintenance will be assumed; make sure decisionmakers recognize the commitment of maintenance resources that is involved.

7. Begin Construction Agency requisitions work force and materials, goes out to bid, and identifies agency staff person to monitor construction; contractor begins construction.
 - * Assist contractor selection.
 - * Obtain access to construction area for designated maintenance staff person(s).
 - * Keep an ongoing list of comments and concerns, urging the necessary changes.
 - * Check for substitutions of materials and deviations from design (especially as relates to drainage, foundations, and other critical aspects of design).

8. Inspect and Accept Final Product. Agency holds end-of-job meeting, sees that performance checklist has been completed, makes final payment, and takes on maintenance responsibility.
 - * Check for complete cleanup.
 - * Make sure all maintenance-related comments and concerns have been resolved.
 - * Get as-built drawings and lists of guarantees, warranties, and parts suppliers.

9. Evaluate Results. Agency conducts post occupancy evaluation to see how design works in operation.
 - * Keep records of maintenance problems that are caused by design or construction.
 - * Call attention to recurrent problems, assisting agency to seek remedies.
 - * Improve design standards to better reflect maintenance concerns.



THE PLUMBER'S ALLEY -
a classic example of design
for maintenance

Notes :

Sample Checklists for Better Design

Since each type of park and recreation facility has its own special maintenance requirements, it is best to develop a number of different checklists for reviewing design alternatives. This section provides five such sample checklists. These checklists are not intended to be complete listings of what the design process needs to consider. They are here to emphasize the need for a detailed and thoughtful analysis that focuses on these specific questions: What maintenance tasks are required by the design? How easily can the design be accommodated into the existing maintenance program?

This section should leave no doubt that maintenance staff have a specific and critically important knowledge to contribute to virtually all aspects of facility design.

The facilities covered include:

- o Day Use Areas -- A Ballfield
- o Overnight Areas -- A Campground
- o Paved Areas -- A Park Road
- o Structures -- A Shelter with Restrooms
- o Minor Structures -- Fences and Fireplaces

* * * * *

DAY USE AREAS -- A BALLFIELD

Access to the Field by Large and Small Service Vehicles

- o Are curbs low enough for large vehicles to cross?
- o Are gates and pavements wide enough and turns adequate to accommodate large vehicles?
- o Are pavements able to support the weight of maintenance vehicles?
- o Is there a place to park trailers bringing equipment?
- o Are small vehicles such as base liners able to get to and from the field easily?
- o Are parking and play sites separated to reduce the risk of damage or injury?

Recurring Maintenance

Daily:

- o Is the infield soil the proper mixture of clay, sand and silt for daily maintenance, good drainage, and adequate feeding of grass roots?
- o Is the field of proper slope to allow water to run off at a rate which will not cause erosion?
- o Is on-site storage of maintenance equipment and supplies required?
- o Are water outlets properly placed for wetting down the field with sufficient pressure available?
- o Is sand available to dry out field?
- o Are trash receptacles adequate to handle litter?
- o Will the fence catch and prevent the spread of litter and allow its easy removal?
- o Is litter under bleachers and other structures accessible?
- o Can collection vehicles get to receptacles?
- o Is dumpster location efficient for both dumping and pickup?
- o Are receptacles easy to empty and easy to clean?

Periodic:

- o Will sprinkler system water only the turf areas?
- o Is the grass type suitable for the intended use, climate, and soil?
- o Can corners be mowed efficiently?
- o Are fences designed for efficient weed control?
- o Are scoreboard, PA system, and lights easily accessible without damaging the field?

Seasonal:

- o Can painted surfaces be sprayed instead of brushed or rolled?
- o Are bleachers, fences, and dugouts designed with rugged, standardized features that minimize and facilitate repairs by regular maintenance crews?
- o Will space and shape of the area permit all grading and field preparation equipment to be used efficiently?
- o Can the sprinkler system be easily drained when necessary?
- o Are drains and valves accessible and easy to replace and repair?
- o Are sprinkler head patterns and heights adjustable?

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OVERNIGHT AREAS -- A CAMPGROUND

Access to Campground

- o Are roads capable of handling both visitor and maintenance traffic?
 - Are there dangerous corners and intersections?
 - Can vehicles make grades and corners?
 - Can bridges and tunnels accommodate large vehicles?
- o Is access controlled to discourage intruders?
- o Are roads all-weather, requiring little maintenance?
- o Are roads well-defined and marked to discourage off-road use?

Surface Material and Drainage

- o Are surface materials low-maintenance, durable, and easy to replace and repair?
- o Do surface materials promote drainage?
- o Do surface materials define campsites, trails, roadways, and parking areas?
- o Are surface materials satisfactory for parking, walking, tenting, and cleaning by the campsite user?

Site Furniture

- o Are tables and fireplaces easy to use, oriented to the vehicle as well as a tent site? (Do they minimize user frustration?)
- o Is furniture durable, easy to clean, low-maintenance, and easy to repair or replace?

Circulation Patterns

- o Do trails and roads have a minimal number of crossings?
- o Do trails take the same routes campers take?
- o Do trails and roads drain adequately?
- o Are roads in campgrounds one-way?

Support Facilities

- o Is maintenance access to support facilities easy?
- o Are support facilities vandal-resistant?
- o Is visitor access to support facilities easy?
- o Is winter shutdown easy to accomplish?

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PAVED AREAS -- A PARK ROAD

Access

- o Are large maintenance and emergency vehicles able to enter roadway easily without backing or running over curb?
- o Are there unnecessary dips or grades at access points?
- o Are barriers used to discourage vehicles from entering and leaving the roadway at unauthorized points?
- o Are roads wide enough to take traffic for which intended?

Materials

- o Are road base and surface adequate to support the maximum loads anticipated?
- o Are road base and surface types and depths appropriate for site conditions?
- o Are surface materials appropriate for the use intended?
 - Is surface smooth for snow removal?
 - Is surface sticky (to prevent slipping) in campgrounds and other people places?
- o Is surface material of a type adequate to insure year-round use?
- o Do surface materials minimize the cost of cyclic maintenance? (For example, some materials can be inexpensively seal-coated, with resurfacing needed less often.)
- o Does base material promote drainage?

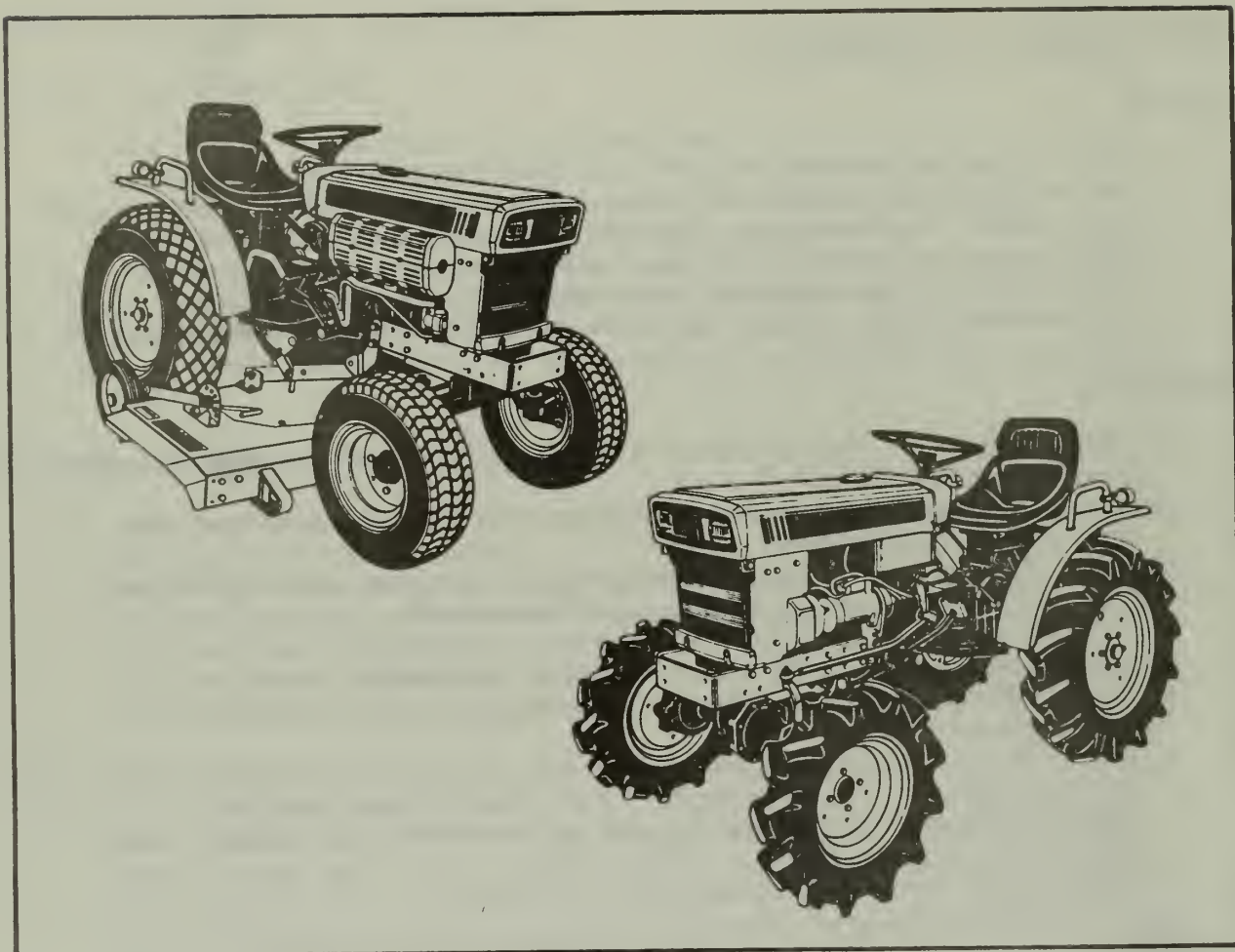
Drainage

- o Are roadside ditches adequate to handle runoff?
- o Is there a danger of flooding in low sections of roadway?
- o Does roadway have "pockets" that collect water?
- o Does water exit pavement quickly to reduce amount of moisture on roadway during precipitation?
- o Does subsurface of roadway drain adequately?
- o Is roadway built on or near a spring?
- o Is curb and gutter construction needed to control the drainage?

Recurring Maintenance

- o Is repair material available at a reasonable cost?
- o Are mowing strips the proper size for mowing equipment?
- o Do borders confine soil and make trimming easy?
- o Are slopes along roadway stable or able to be stabilized?
- o Are storage facilities adequate for equipment and supplies?

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STRUCTURES -- A SHELTER WITH RESTROOMS

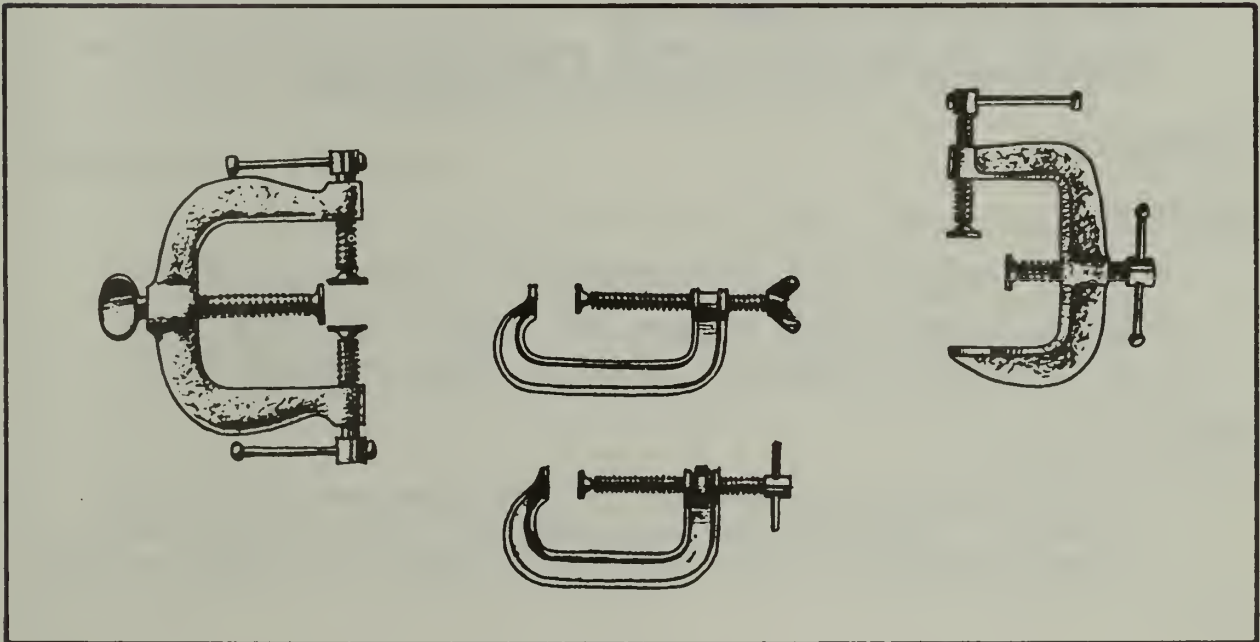
Access to Shelter

- o Are service vehicles and equipment able to get easily to where they are needed?
- o Are pavements wide enough and turns adequate for the driver to maneuver his vehicle?
- o Are pavements and approaches able to support the weight of service vehicles?
- o Do doors, ramps, and steps permit service vehicles to approach building in a manner that allows for efficient use?

Recurring Maintenance

- Are surfaces easy to clean, repair or replace, and are they spot- and stain-resistant?
- Are fixtures standardized, located for efficient maintenance, and durable?
- Are all fixtures, especially toilets and sinks, and surrounding areas easy to clean?
- Does the structure minimize collection points for dust, cobwebs, and trash as well as hard-to-clean areas such as ledges, corners, and rafters?
- Are pest habitats and access points eliminated or discouraged?
- Are floors, walls, and tables designed to drain and air dry?
- Is there adequate storage in the proper location for maintenance equipment and supplies as well as tables, chairs, and other equipment requiring periodic storage?
- Are paper dispensers easy to fill and designed to discourage overuse?
- Are utility service points and lines easily accessible for maintenance yet not accessible to the public?

* * * * *



MINOR STRUCTURES -- FENCES AND FIREPLACES

FENCES

Materials

- o Are materials durable--rust and rot resistant?
- o Are fences constructed of materials standard throughout the system?

Safety

- o Does the design, by minimizing footholds and attractive handholds, discourage climbing?
- o Are openings that can trap children and animals eliminated?
- o Are jagged edges and sharp corners eliminated?

Vandalism

- o Are posts and gauge of wire the proper size to discourage damage by vandals?
- o Are wood fences located away from fireplaces where they might be used for fuel?
- o Are fences placed the proper distance from parking lots to prevent damage from bumpers?
- o Are fences part of landscape design and not isolated targets?

Recurring Maintenance

- o Is mowing and trimming easy?
- o Are fences designed to have small sections that can be repaired or replaced easily at little cost?

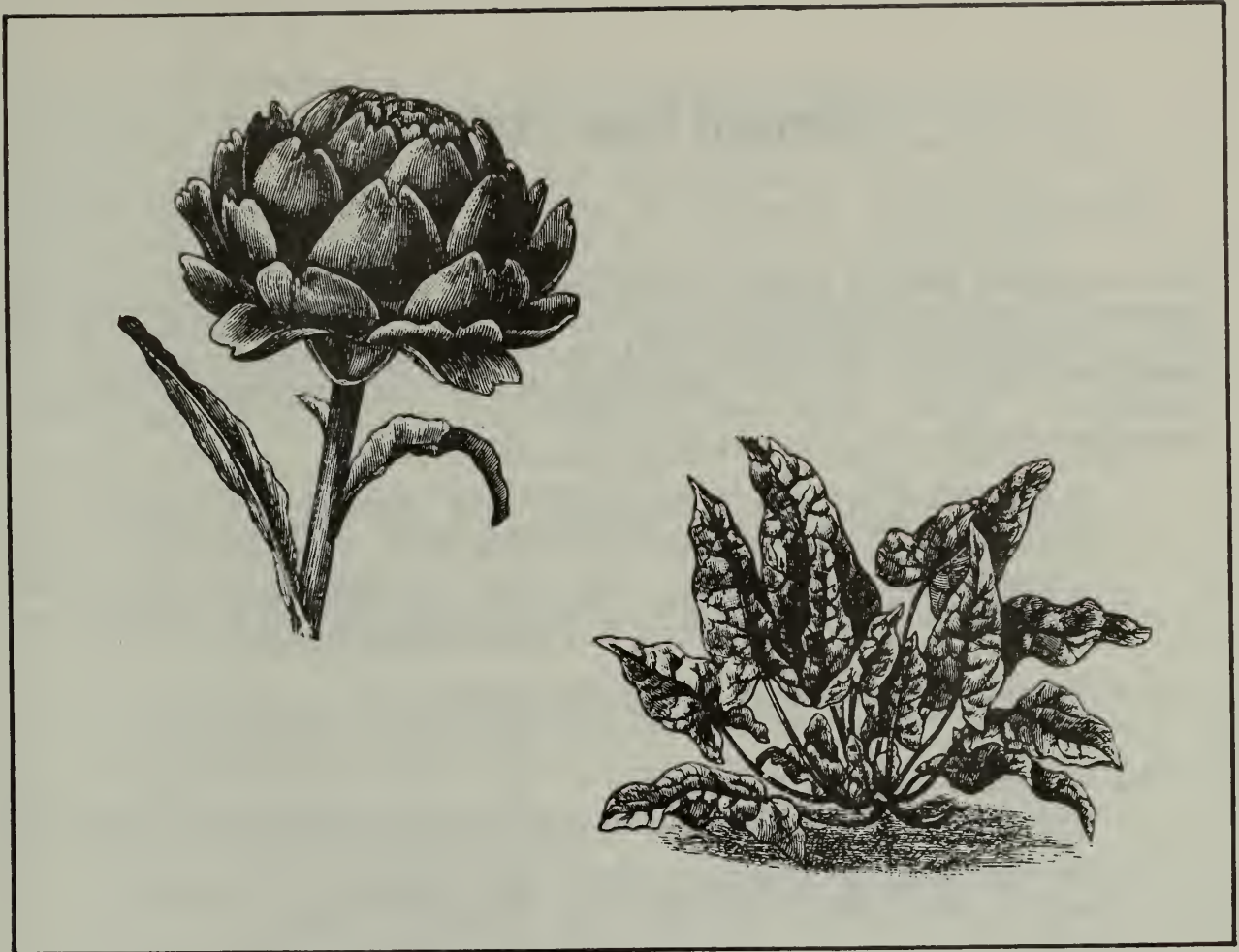
FIREPLACES

Materials

- o Are materials able to withstand high heat for long periods?
- o Are materials easy to maintain, repair and replace?
- o Are materials durable enough to resist vandals?.

Design for Use

- o Is the design appropriate for the expected use? (For example, a picnic area may require a waist-high stove, a campground may require a stove to cook full meals or use



as a campfire, and both may need space for a portable stove.)

- o Is the grate adjustable for different fuels, cooking needs, and weather conditions?

Recurring Maintenance

- o Is cleaning of the grates, fire box, and surrounding area easy?
- o Is there a nearby depository for hot coals?
- o Are ashes controlled and easily removed with available equipment?
- o Are movable parts vandal-resistant and easy to replace?

* * * * *

Selected Case Studies

Case studies can be a good tool for showing concepts in action. The agencies here are giving maintenance a place in the planning and design of facilities. Some of these case studies relate to how the planning and design process can be improved. Others show how site-specific design solutions can ease the burden on the maintenance budget.

- A MAINTENANCE IMPACT STATEMENT FOR PROPOSED PROJECTS
Walnut Creek Public Service Department, California
- A BEAUTIFICATION PROGRAM THAT CUTS MAINTENANCE COSTS
Wellesley Parks and Tree Division, Massachusetts
- A MULCH BUFFER THAT STRETCHES STAFF
Boulder Parks and Recreation Department, Colorado
- A REDESIGNED PROBLEM PARK
Colorado Springs Parks and Recreation Department, Colorado
- AN UNDERGROUND NATURE CENTER THAT WORKS
Dayton-Montgomery County Park District, Ohio
- A PUBLIC RELATIONS CAMPAIGN TO EXPLAIN CHANGE
Ohio Department of Natural Resources
- A POST OCCUPANCY EVALUATION TO CHECK RESULTS
(City of) Los Angeles Department of Parks and Recreation,
California

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A MAINTENANCE IMPACT STATEMENT FOR PROPOSED PROJECTS

Contact: Walnut Creek Public Service Department, 1445 Civic Drive, Walnut Creek, California 95690

Back in 1973, Walnut Creek's Public Service Department began to feel the budget pinch. The department's maintenance responsibilities were rapidly increasing, but its budget was not. Since the department is responsible for the maintenance of city streets, storm drains and traffic signals in addition to the maintenance of parks, civic areas, golf courses, street trees and street medians, it was particularly motivated to see consideration of maintenance costs become established policy.

Against the backdrop of increasing responsibility with no opportunity to provide input, the Public Service Department originated the idea of a "maintenance impact statement" and proposed that it be prepared for all projects that would require maintenance support. The maintenance impact statement would make available in a single document the information needed to estimate budget requirements, get agreement on maintenance levels, and improve facility design. The City Council would have the benefit of this information, and the insight and experience of maintenance staff, at the time it was asked to grant approval for construction.

In Walnut Creek, the maintenance impact statement has become a tool for: 1) insuring maintenance input into the design process; 2) linking the planning and design process to the budget process; and 3) storing and communicating information useful to decisionmakers, planners, maintenance staff and taxpayers alike. The statement is kept as brief as possible but covers such information as:

- o description of the project or program
- o proposed type and level of maintenance services
- o suggestions for minimizing maintenance requirements
- o estimated annual cost of maintenance services
- o the date services need to start
- o alternatives considered

For Walnut Creek, the benefits of the maintenance impact statement have been undisputed. Today, city staffs work together more constructively and project approval is more likely to carry with it adequate resources for the maintenance job. Additionally, the maintenance impact statement has helped justify equipment purchases, prompted development of design criteria for median landscaping, and led to agreement on grounds maintenance service levels citywide.

A BEAUTIFICATION PROGRAM THAT CUTS MAINTENANCE COSTS

Contact: Wellesley Parks and Tree Division, Board of Public Works, P.O. Box 364, Wellesley, Massachusetts 02181

Even within the severe budget constraints imposed by a newly enacted state law limiting taxation, Wellesley residents have supported the use of capital outlay monies for traffic island beautification. The city has made sure that the beautification

TRAFFIC ISLAND BEAUTIFICATION COST EFFECTIVENESS

TRAFFIC ISLAND	FISCAL YEAR OF IMPROVEMENTS	ANNUAL MAINTENANCE MANHOUR REQUIREMENTS	
		Before Beautification	After Beautification
Foxhill/Sagamore	1968	5 times/yr x 1 hr. = 5 m.h. to mow	2 times/yr x 1 hr. = 2 m.h. to weed & trim
Upland Rd. Circle	1970	5 times/yr x 1 hr. = 5 m.h. to mow	2 times/hr. x 1 hr. = 2 m.h. to weed & trim
Beverly/Chesterton	1972	12 times/yr x 1 hr. = 12 m.h. to mow	2 times/yr x 2 hr = 4 m.h.to weed & trim
Wellesley/Forest	1974	5 times/yr x ½ hr = 2½ m.h. to mow	1 time/yr x 1 m.h. = 1 m.h. to weed & trim
Abbott/Inverness	1975 & 1980	8 times/yr x 1 hr = 8 m.h. to mow	2 times/yr x 4 hrs. = 8 m.h. to weed & trim
Wellesley Main Library	1979	12 times/yr x 1 hr = 12 m.h. to mow	3 times/yr x 1 hr = 3 m.h. to weed & trim
Pilgrim/Brookfield	1979	5 times/yr x 1 hr = 5 m.h. to mow	2 times/yr x 2 hr = 4 m.h. to weed & trim
Central/Cross	1979 & 1981	Paved - no maintenance	3 times/yr x 1 hr = 3 m.h. to weed & trim
Eaton Court	1980	12 times/yr x 3 hrs = 36 m.h. to mow	3 times/yr x 4 hrs. = 12 m.h. to weed & trim
Damien Circle	1980	5 times/yr x 4 hrs = 20 m.h. to mow & trim grass	5 times/hr x 3 hr = 15 m.h. to mow less grass & weed groundcover
Weston/Turner	1980	5 times/yr x 8 hrs = 40 m.h. to mow	5 times x 8 hrs = 40 m.h. to mow - project incomplete
Washington/Dover	1980	12 times/yr x 1 hr = 12 m.h. to mow	2 times/yr x 3 hrs = 6 m.h. to weed & trim
Clark Rd. Circle	1980	5 times/yr x 3 hrs. = 15 m.h. to mow	5 times/yr x 2 hrs = 10 m.h. to mow less grass & weed groundcover
Hundreds/Garden	1981	4 times/yr x 6 hrs.= 24 m.h. to trim hedge	3 times/yr x 2 hrs. = 6 m.h. to weed & trim
Washington/Glen	1981	16 times/yr x 2 hrs.= 32 m.h. to mow	4 times/hr x 2 hrs. = 8 m.h. to weed & remove dead flowers
TOTAL MANHOURS		228½ M.H.	124 M.H. 26% or 104½ m.h. savings

program also reduces maintenance and operational costs. Traffic islands have been modified to require routine maintenance no more than a few times yearly, and to require no watering past the second or third year after installation of vegetation.

Each traffic island has been treated differently. Some islands have been enlarged by city engineers for better traffic control. In other cases, granite curbing has been added to better contain soil and vegetation, ground cover or wood chips have been installed to replace turf, or trees and shrubs requiring minimum maintenance have been planted. While each individual case has had little impact on the maintenance operation, altogether the savings in man-hours has been significant. Where previously 228 1/2 man-hours were needed to do the job, it now takes 124. Additionally, to the extent that mowing has been reduced, vehicle costs have been cut as well.

So far, the city has been able to complete modifications at fifteen of its 54 traffic islands (at a cost of about \$1000 per island), and intends to make traffic island beautification a continuing program. The Wellesley experience shows that, when maintenance considerations are incorporated into the planning process, even small design changes can cut maintenance costs. Well received by citizens, the Wellesley program both beautifies the city and eases its maintenance burden.

A MULCH BUFFER THAT STRETCHES STAFF

Contact: Boulder Parks and Recreation Department, P.O. Box 791, Boulder, Colorado 80302

The Boulder Department of Parks and Recreation faced a situation common to many agencies. The department was taking on new parks without receiving additional funds for their maintenance. Unless the maintenance operation became more efficient, services would suffer at all park units.

The department's computerized cost tracking system, which can aggregate costs by fund, geographic district, and 90 different tasks, helped confirm how maintenance dollars were being spent. A recent year-end printout showed that 16% of the total maintenance budget went for mowing and trimming at over 40 different locations. Since Boulder's parks have many trees, shrubs, and other plantings, the department resolved to make mulching a policy. Simply by incorporating a ring of wood chips around all plantings, much labor intensive hand trimming was eliminated. Mulching has had additional advantages, including:

- o Water Conservation. By increasing infiltration and reducing evaporation, mulch helps to use water more efficiently and to maintain uniform soil moisture and temperature.
- o Reduced Machinery Damage to Plants. Plants weakened by machine injuries are easy prey for insects and disease. (In Boulder, mulching has eliminated a major cause of tree loss so that far fewer new plantings are today required.)
- o Increased Growth. Competition from turf can slow growth of some species when first planted. A mulched ring can increase growth potential.
- o Weed Control. A layer of wood chips, 4 to 6 inches deep, discourages weed growth.
- o Soil Improvement. As mulch decomposes, soil structure and organic content improves.
- o Appearance. Wood chip mulch can emphasize and enhance landscape design. The landscape often appears neater to users.
- o Use of a By-Product. Chips produced by trimming and pruning operations are recycled into a useful product.

To create a successful mulch buffer, Boulder's parks superintendent suggests these procedures.

1. Use high fiber, low-leaf-content mulch. Stump removal chips are very good.
2. Use a 4 to 6 inch layer. This depth controls weeds yet allows water to penetrate.
3. Mulch a large enough area to stop mower damage and reduce competition from turf.
4. Wet down thoroughly to avoid wind erosion.
5. Install after first frost to discourage small rodents as well as make best use of available manpower.

Like all design features, mulch buffers have their own maintenance requirements. These requirements need to be anticipated so that they can be incorporated into the maintenance program. For example, the design will require the recovery, cleanup or addition of new chips to replace windblown, child-thrown, and decomposing chips. Additionally, while organic mulches such as wood chips add small amounts of nutrients to the soil as they decompose, they also deplete the

soil of nitrogen and thus should not be considered a substitute for fertilizer. The soil will require regular applications of nitrogen to treat chlorosis from nitrogen loss.

Boulder's parks superintendent estimates that mulching has made the entire mowing and trimming operation about 10 to 20 percent more efficient. A more important benefit, however, is not apparent from these figures alone. Chips can be installed during cold weather, eliminating the need for hand trimming during the busy season. This more even demand on manpower insures a smoother operation and a staff that stays productive all year round.

A REDESIGNED PROBLEM PARK

Contact: Colorado Springs Parks and Recreation Department,
1400 Glen Avenue, Colorado Springs, Colorado 80905

Many old parks no longer serve the needs of their community. In Colorado Springs, a 100-year-old downtown park was attracting vandalism, drug dealing, and mugging. By redesigning the park to better meet present-day user and management needs, the city was able to reduce some of these problems.

- o A dense wall of lilac bushes, over six feet tall and surrounding the park, was removed. Bushes were left at corner entrances and selected spots along the perimeter of the park.
- o An old bandshell was refurbished to once again allow use by local groups. Restrooms were eliminated from the bandshell.
- o The shuffleboard building was rebuilt to allow for better control and to make it possible to observe the entrances to new smaller restrooms now housed in the building. Building entrances were secured during non-operating hours by heavy metal pull-down doors.
- o Lighting was installed to reduce hiding areas at night.
- o Access to the park was redesigned to allow easy police patrol and response.
- o Repaired sidewalks and a center plaza circled by benches helped draw park activities to the center of the park. Flowers were planted in beds and hanging baskets.

- o Park regulations were posted on trash receptacles and at legal entrances to the park.

Capitalizing on the park's new look, the Colorado Springs agency helped organize surrounding merchants for the purposes of monitoring crime and setting up a donation account. And, to stabilize usership, the park now has a regular schedule of activities that includes farmers' markets and noontime concerts.

While problems have not been eliminated, they have been reduced, largely due to the increased use the park now receives. And today the park is better designed to withstand the abuse it does receive. The parks superintendent has observed yet a third factor: the park's new face has not only rekindled community interest but has encouraged users to take better care of their facility (as evidenced by reduced litter). In the Colorado Springs experience, maintenance dollars are better spent when a park serves a larger and broader segment of the public.

AN UNDERGROUND NATURE CENTER THAT WORKS

Contact: Leland Center, 1375 E. Siebenthaler Avenue, Dayton, Ohio 45414

The Dayton-Montgomery County Park and Recreation District arrived at an innovative design solution to hold down the cost of operating and maintaining a multipurpose interpretive center. Built "underground", the center exemplifies comprehensive and cost-conscious design.

The 82' x 45' center is constructed of reinforced concrete and block. The thirty inches of earth covering the building act as a natural insulator, allowing thermostats to be left at 56 degrees year-round. The building requires no air-conditioning system, but does use a circulation and dehumidifying system to maintain proper humidity. A single wood-burning stove satisfies most heating requirements, assisted by passive solar gain and backed up with electric baseboard heat.

A well, downslope from the center, supplies four pressure tanks and is the water system for the center and adjacent picnic area. The toilet system requires no water. Liquid waste disposal is accomplished by a non-flushing organic composting toilet and grey-water septic system.

The center's unusual design, with its single exposed wall of natural finish concrete, means that routine exterior maintenance is limited to window washing. No painting or staining is required. The roof requires only occasional

mowing, since it is covered by natural vegetation. Interior walls are also natural finish concrete, while the floor is low maintenance quarry wood.

Security problems are minimized by equipping windows with heavy-duty, pull-down metal screens. The center also has a "built-in security system" in the form of a one-room apartment constructed to house a caretaker-student intern. This arrangement discourages vandals while decreasing the need for overtime staffing.

No design feature is without maintenance requirements. But by balancing these requirements with potential savings in energy, water, and security costs, the Dayton-Montgomery County agency found a design solution that minimizes overall expenditures for the center.

A PUBLIC RELATIONS CAMPAIGN TO EXPLAIN CHANGE

Contact: Ohio Department of Natural Resources, Division of Parks and Recreation, Fountain Square, Columbus, Ohio 43224

Whenever design concepts or maintenance procedures are altered, it is a good idea to explain the change, instruct people on how to use the new concept, and invite public response.

For years, the Ohio State Parks had a "clean cut" image. Maintaining that image required a level and style of mowing that added substantially to the agency's maintenance budget. About two years ago, a concern for rising labor costs, rising energy costs, and uncertain energy supplies contributed to a decision to change the mowing policy. The new policy calls for limiting mowing to one pass of the mower at most roadsides, to areas around entrances and signs, and to areas where required by the recreational activity. At campsites, only tent pads are to be mowed. While the impact of the policy has varied from park to park, some of Ohio's parks estimate that the new policy cuts mowing and trimming costs in half.

Anticipating at least some negative feedback from users, the agency's inhouse public relations specialists developed a handout to explain the new mowing policy and design concept. During the first year of the new policy, the handout was distributed widely. Since greatest resistance was noted among campsite users, the handout stressed the benefit of campsites bordered by natural vegetation. According to agency staff, the handout seems to have worked. A survey over the year's three busiest weekends found few negative comments. This year, as a low-cost follow-up measure, the agency's annual newsletter reminds visitors of the new policy and design concept.



Welcome To Ohio State Parks

Dear Camper,

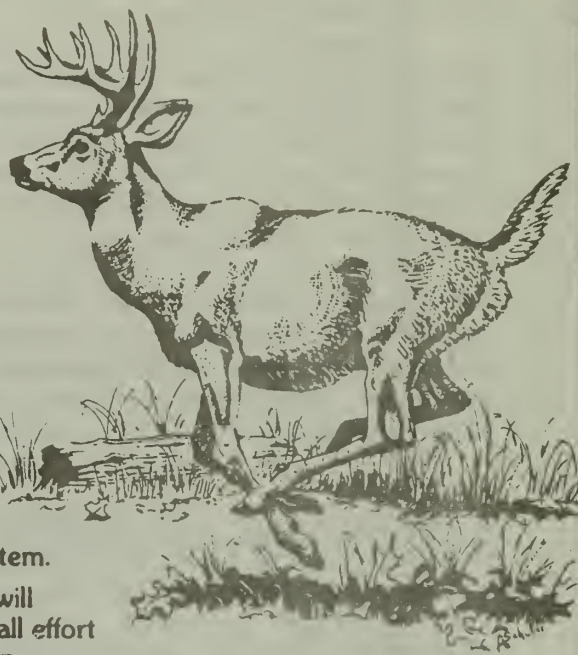
Welcome to Ohio State Parks. This year the Ohio State Parks campground has implemented a centralized garbage collection system.

This system provides centrally located garbage corrals which you will find are within easy walking distance from your campsite. This small effort on your part will provide a great savings of both time and money in comparison with our past refuse collection system. In addition, unsightly garbage cans are no longer scattered throughout the campground and litter is much less apt to be spread about the area by raccoons and other scavengers.

With your help, the new centralized garbage collection system will offer you a more beautiful and better maintained camping facility.

Thank you for your cooperation.

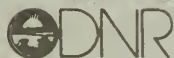
Donald G. Olson, Chief
Division of Parks & Recreation



A New Look...

Ohio State Parks have begun to implement a new concept in a very old process in park maintenance—mowing. The new concept releases areas along park roadsides and entrances from a manicured style of mowing and gently blends the maintained area into the natural area. Some areas which in the past were to be mowed during the summer are now left in a natural state until after all the wildlife young have been born, and most importantly, have left their tall grass shelters. This enhances the opportunities for park visitors to see more wildlife during their stay and provides an addition to habitat much needed in a developed area.

Mowing in other areas has been decreased and the maintenance cost in terms of man hours and dollars can be decreased. These savings help to balance the overall park budget, reduce usage of valuable gas and allow the park to continue to provide recreational opportunities in an even more natural setting. With a tightening economy and concern about energy conservation on the forefront of everyone's mind, a trend away from manicured mowing is only natural. Playground and other recreational areas will be mowed as in the past. As an added benefit, campers will now find campsites nestled into an area whose borders are softened by both the new vegetation and trees planted by the park staff. These borders will provide shade as well as natural beauty in years to come. It is our hope that you will enjoy this new style of campsite and will appreciate the increased beauty of the surroundings.



Ohio Department of Natural Resources
DIVISION OF PARKS & RECREATION
Fountain Square • Columbus Ohio 43224



JAMES A. RHODES, Governor • ROBERT W. TEATER, Director • DONALD G. OLSON, Chief

POST OCCUPANCY EVALUATION TO CHECK RESULTS

Contact: City of Los Angeles Department of Recreation and Parks, Planning and Development Branch, Room 1290, 200 North Main Street, Los Angeles, California 90012

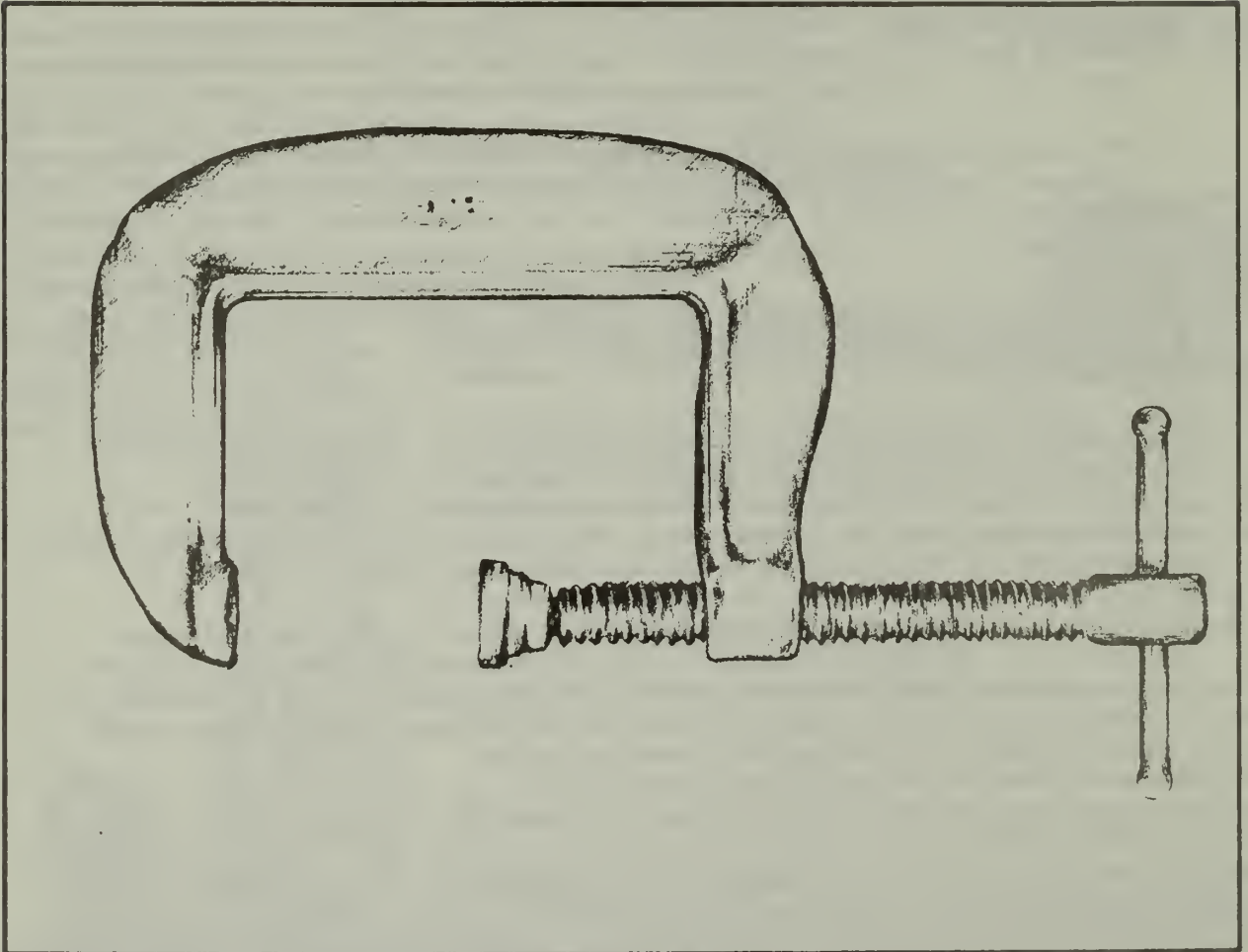
The Los Angeles Department of Recreation and Parks has established a procedure to insure that past successes and inadequacies are incorporated into future designs. The agency conducts a "post occupancy evaluation"(POE) to determine how well a specific design actually works. The POE process requires that the agency get several viewpoints, including that of management, maintenance staff, and user. The evaluations are fed back into the design process and result in repeating good design features and eliminating poor ones. When doing a POE, the agency focuses on several key questions, beginning with whether the facility, in fact, fulfills the function for which intended. The process typically follows the sequence outlined here.

1. Evaluate the design concept and its communication within the department and community. (How well are user needs being met? Do department and community know why facility was built and what needs are to be met?)
2. Determine project constraints, such as those imposed by budget, schedule, special needs to meet or issues to resolve; use this information to understand the finished product.
3. Evaluate the construction phase. (Were any construction problems design-related? Which design innovations proved worthwhile?)
4. Conduct walk-through discussions with those who operate the facility, compiling a list that includes both negative and positive design features. (How well can programs be run? How well can facility be maintained and managed? Which facility features are most liked?)
5. Identify recurring problems and consistent breakdowns, getting designer and project/construction manager input as to why they occur; find ways to remedy the problems in this and future facilities. (Are there design features to repeat or avoid?)
6. File data and evaluations for use in future designs.

One individual in the agency's Planning and Development Branch has responsibility for the POE process. This person coordinates staff input, takes care of the paperwork, and keeps

records for future use. The evaluation is begun about seven months after a facility's acceptance from the contractor. This allows enough time to correct problems that may be under warranty, and makes the POE a useful tool for remedying existing problems as well as preventing future ones. (The city can, for example, take legal steps against contractors who refuse to correct problems, barring them from future bidding.)

To date, the POE process has identified countless problems that are design-related. Often, POE findings have prompted the agency to review and improve its existing design standards. For example, the agency no longer installs brands of sprinkler heads that are too easily disassembled, vandalized, or lopped off by mowers. Other POE-related changes include: no longer planting spiny-thorned natal plums; stipulating repeat cycles when irrigation plans involve hillsides; and, in certain facilities, requiring a special paint that makes graffiti easier to remove.



Sources of Additional Information

Park and recreation administrators agree that the best way to find out about sound maintenance practices is to build good communications with other agencies who are doing a good job. These agencies will also have ideas on how to effectively incorporate maintenance into area and facility design.

- o Get acquainted with people who are running efficient park systems. Large agencies, because of the size and cost of their operations, often have well-developed guidelines and manuals based on the research and best knowledge of many people.
- o Get acquainted with private and commercial providers of park and recreation services.
- o Attend state, regional, and national meetings and discover what others are doing. Seek out and cooperate with practitioners who have problems common to your own.
- o Correspond with professional associates who may have new ideas or proven records of achievement in developing better park operations.

Get acquainted with key people in local, state, and federal park and recreation agencies who may be in a better position than you to have widespread contacts and well-organized sources of information. Universities are a prime source of information and assistance. Those with park and recreation or related programs may have training materials and faculty whose job is to be familiar with good park practices everywhere. Some universities have extension services available to assist local governments.

Equipment and materials suppliers can provide valuable information about their products and applications to park use. Commercial product representatives may have valuable experience gained through sales contacts and interest in providing good service to customers.

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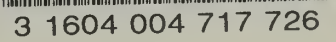
Two good sources of up-to-date information are:

Park Practice. This subscription publication program is offered cooperatively by the National Recreation and Park Association and the National Park Service. The excellent collection of back issues make up an outstanding library of useful information. To find out more, write: Park Practice, National Recreation and Park Association, 3101 Park Center Drive, Alexandria, VA 22302; (or) Office of Cooperative Activities, National Park Service, Washington, DC 20243.

Information Exchange. This program assists the park and recreation practitioner by providing up-to-date technical information on a wide range of topics. Among the publications available is the Maintenance Impact Statement Handbook. SHARE is a service of Information Exchange which utilizes a computerized information retrieval system to store and retrieve information submitted by park and recreation professionals covering many aspects and problems. To find out more, write: Information Exchange, U.S. Department of the Interior, National Park Service, Division of Recreation Resources Development, 440 G Street N.W., Washington, DC 20243.

Many periodicals regularly contain articles about design for maintenance. These include:

American City and County Public Works Engineering and Management. Berkshire Common, Pittsfield, MA 01201
Grounds Maintenance. Intertec Publishing Corporation, 9221 Quivera Road, Overland Park, KS 66215
Landscape and Turf Industry. Brantwood Publications Inc., P.O. Drawer 77, Elm Grove, WI 53122
Landscape Architecture. American Society of Landscape Architects, 1190 East Broadway, Louisville, KY 40204
Managing Leisure Facilities. Billboard Publications Inc., Amusement Business Division, Box 24970, Nashville, TN 37202
Park Maintenance and Grounds Management. National Institute on Park and Grounds Management, Box 1936, Appleton, WI 54913
Public Works. Public Works Journal Corporation, Box 688, Ridgewood, NJ 07451
Weeds, Trees and Turf. Harcourt, Brace, Javanovich Publications, *1 East First Street, Duluth, MN 55802
Western Landscaping News. Hester Communications Inc., P.O. Box 19531, Irvine, CA 92713

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